Lubrication ENGINEERING

JOURNAL OF THE AMERICAN SOCIETY OF LUBRICATION ENGINEERS

Trabon HELPS SET WORLD'S 24-HOUR TONNAGE RECORD!

At United States Steel's Homestead Works, a slab mill built by United Engineering and Foundry Company has rolled 11,153 net ingot tons in 24 hours, top record for this type of mill.

This mill, the first slab mill to use anti-friction bearings on the roll necks, is lubricated by Trabon oil and grease systems.

Lubrication costs are extremely low in comparison to similar mills.

You can cover the sealed Trabon system with scale, ice, steam, water and snow without interfering with its operation.

Trabon centralized lubricating systems are widely used on plate mills, slabbing, hot and cold strip mills, blast furnaces, overhead traveling cranes, and other heavy equipment. One indicator at the pump, Trabon systems lubricate every connected bearing with the right amount of lubricant—while the machine is in operation under full load.

Let Trabon engineers help you with your lubrication problems. World-wide service.

TRABON ENGINEERING CORPORATION
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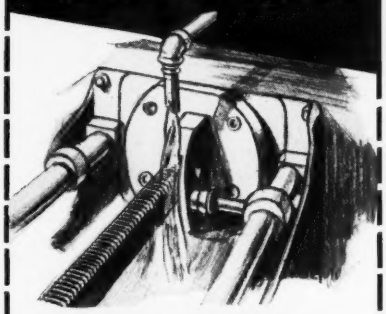
"Trabon has the only completely enclosed measuring valve that notifies the operator if trouble develops!"

Trabon

OIL AND GREASE SYSTEMS

TOUGH
or
EASY
machining...



MORE THAN A "COOLANT" IS NEEDED

LITERALLY thousands of plants will testify that Stuart cutting fluids have been their only answer on *really tough* machining jobs. The research and experience that makes Stuart a leader on the tough jobs pays real dividends on the easy jobs. Stuart knows that *more than a "coolant" is needed* — that cooling, lubricity and anti-weld characteristics must be combined in a cutting fluid if optimum finish, tool life and production are to be secured.

This doesn't mean that you must have a different cutting fluid for every job, but it does mean you need a cutting fluid that is *right* for the job.

Send for NEW BOOKLET "MORE THAN A COOLANT IS NEEDED" and ask a Stuart representative to show you how the planned application of Stuart cutting fluids will give you more output, longer tool life, better finish and lower cost.

Offices in Principal Industrial Centers

TIME-TESTED Cutting Fluids and Lubricants

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Lubrication ENGINEERING

Vol. 8, No. 3 *JUNE, 1952*

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LUBRICATION ENGINEERING

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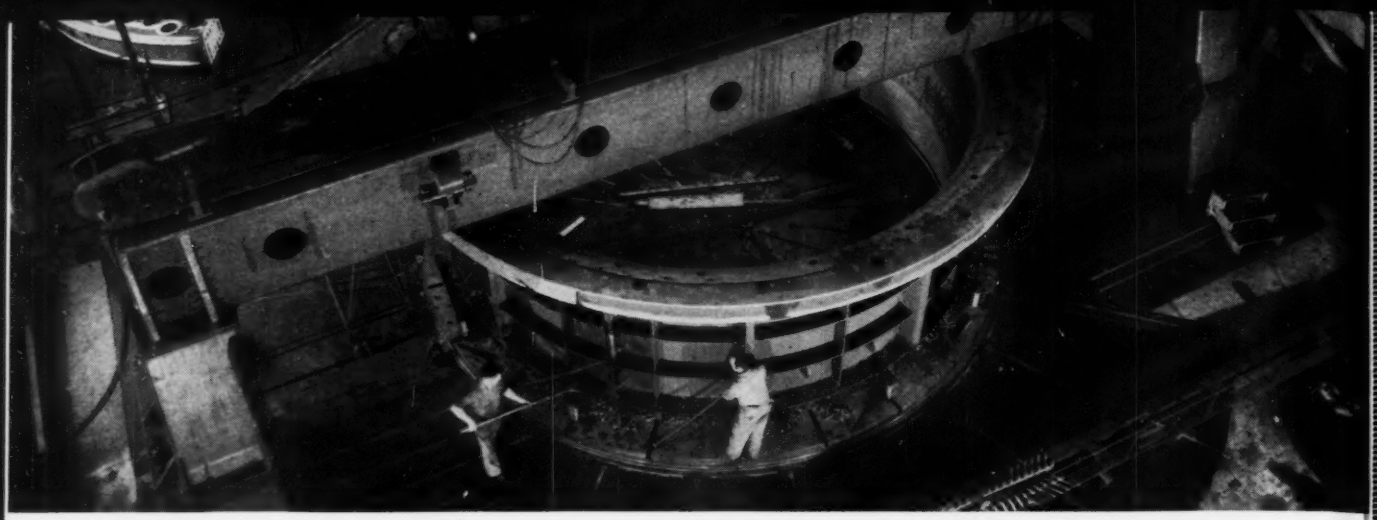
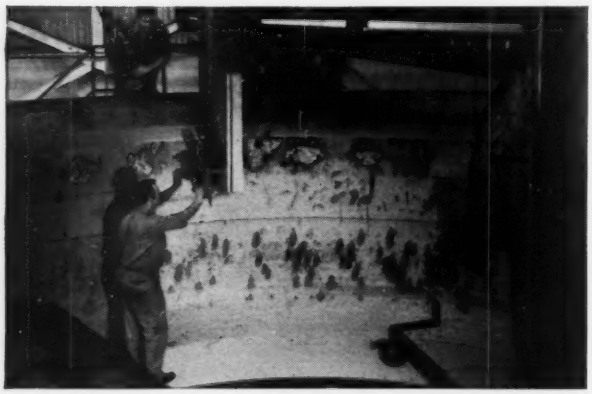


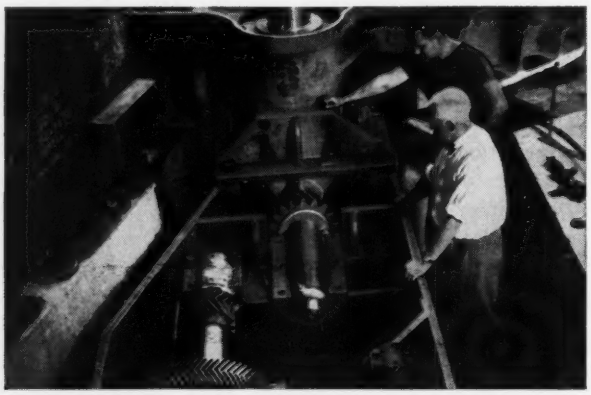
$400,000 VERTICAL BORING MILL, one of the world's largest, bores, turns and faces hydraulic turbine parts. Sunoco Way Lubricant, approved by 39 machine tool builders, was selected by the design engineers to prevent stick-slip with resultant scoring of ways and slides. Even under the weight of work as heavy as 75 tons, Sunoco Way Lubricant has never squeezed out.

TURBINE PARTS 62 FEET IN DIAMETER MACHINED BY HUGE VERTICAL BORING MILL

This mill was installed eight months ago by S. Morgan Smith, well-known hydraulic turbine manufacturer. Without alterations, it can take work up to 22 feet high with a maximum swing of 42 feet between housings. By removing the housings and adding a head to the face plate, it can be modified to handle parts 62 feet in diameter. Sunoco Way Lubricant, specified for the ways and rails by the design engineers, has been used exclusively. The mill accommodates work that weighs as much as 75 tons. No jump or stick-slip has ever marred a finish or impaired accuracy. The ways and rails remain like new. This is typical of the performance that has won the endorsement of 39 machine tool builders for Sunoco Way Lubricant. For an informative booklet and sample, write on your business letterhead to Sun Oil Company, Department LE-6, Phila. 3, Pa.



ELECTRONICALLY CONTROLLED CUTTING TOOLS machine a turbine discharge ring 9' high, 27' 8" dia., 21' 8" bore. Sunoco Way Lubricant keeps rails free of rust and corrosion. Starting up after week-end shutdowns, tables and other parts move freely on the ways and slides without jump or stick-slip.



THE SYNCHRONOUS GEAR DRIVE, controlling table speeds from .094 to 6.045 rpm., is pressure-fed with another Sun "Job Proved" product—Sunep. This extreme pressure lubricant is exceptionally stable, minimizes wear, gives long-time protection to very heavily loaded teeth in many types of gear boxes.

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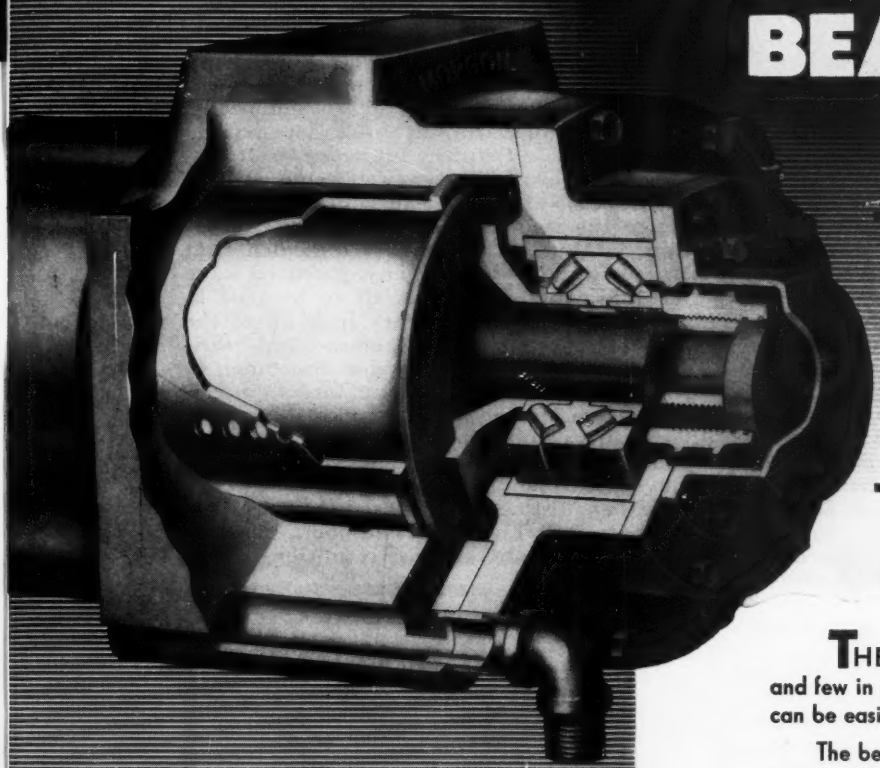
ROLL NECK BEARINGS



....insure accurate products
...last a long time
....require little maintenance

THE essential parts of the bearing are simple and few in number . . . making a compact unit that can be easily removed from the roll neck.

The bearing operates on a film of oil which has tremendous load carrying capacity, hence there is no wear. The load is distributed over a large area with no points of concentration, so fatigue failures of bearing parts are unknown.

The operation of a bearing under hydro-dynamic lubrication results in an extremely low coefficient of friction and low power requirements.

The absence of wear in the radial bearing and the close control of axial roll movement afforded by the thrust bearing, permits the rolling of both sheets and sectional products within extremely close tolerances.

May we tell you more about the success of Morgoils on new or existing mills?

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DOW CORNING

Silicone Notes

ON LUBRICATION

REFERENCE NO. SL-53

FILE SILICONE LUBRICANTS

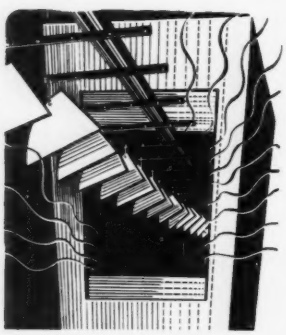
Make sure you have basic data sheets 8G-2, 5501b, 7102. If misplaced write Department 8W-18

DOW CORNING CORPORATION
Midland, Michigan

DOW CORNING 41 GREASE

Bearings working at 375°F. in an oven conveyor system for baking the finish on electrical parts, failed frequently in spite of weekly relubrication. And many finished parts had to be rejected because of flaws caused by oil bleeding out of the bearings and dripping onto the uncured paint. Since using Dow Corning 41 Grease, bearing failure and rejects caused by melting grease have been eliminated, and the bearings have to be relubricated only twice a year.

After more than 30 months of service, conveyor bearings lubricated with Dow Corning 41 Grease are still running smoothly through an enamel drying oven operating at 300°F.



Bearing failures have been eliminated, maintenance and lubrication costs have been reduced to the vanishing point; production has been increased by at least the $100 worth of parts a day that were formerly rejected because the finish was spoiled by the dried-up, graphite-kerosene lubricant that fell down from the bearings.

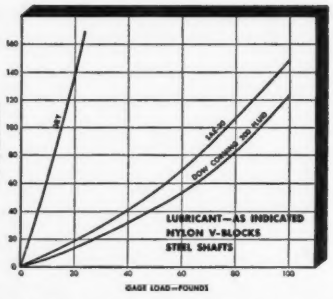
As an antiseize agent on the die threads of glass forming machines, Dow Corning 41 Grease makes it easy to take dies apart even after 6 months of operation at 340-380°F. Similarly, die assemblies used in molding phenolic closures formerly froze so tight that a welding torch was used to cut the dies and bolts apart. The same assemblies lubricated with Dow Corning 41 are easy to disassemble after long exposure to heat and steam. Hold-down bolts on rubber and plastic presses are also lubricated with Dow Corning 41 to prevent seizure.

DOW CORNING 200 FLUID

The ability to lubricate is a complex of so many variables that no absolute value can be given for any lubricant. Speed and load, bearing design and metal combinations, time and temperature all have a more marked effect on wear than the lubricant itself has. That fact has been very well demonstrated in the case of the silicone lubricants.

Take the Dow Corning 200 Fluids, for example. Our first experience indicated that these fluids had little, if any, potential value as lubricants. That seemed to be true in spite of the fact that they have all of the other properties required of an ideal lubricant. They show remarkable resistance to oxidation and to gumming for an indefinitely long period of time and at high temperatures. Volatility is very low and they have an exceptionally flat viscosity-temperature slope.

Further investigation showed that the Dow Corning 200 Fluids are, in fact, excellent lubricants under certain conditions. They are, for example, the best of all lubricants for plastic and fiber gears and bearings. In this case, and unlike most silicone lubricants, the Dow Corning 200 Fluids seem also to have better load carrying capacity as indicated by this graph based on Falex test results.



The superiority of these fluids as lubricants for nylon gears and bearings is further indicated by the fact that wear should be more exactly defined as deformation due to the heat of friction rather than loss of material due to wear.

DOW CORNING CORPORATION • MIDLAND, MICHIGAN

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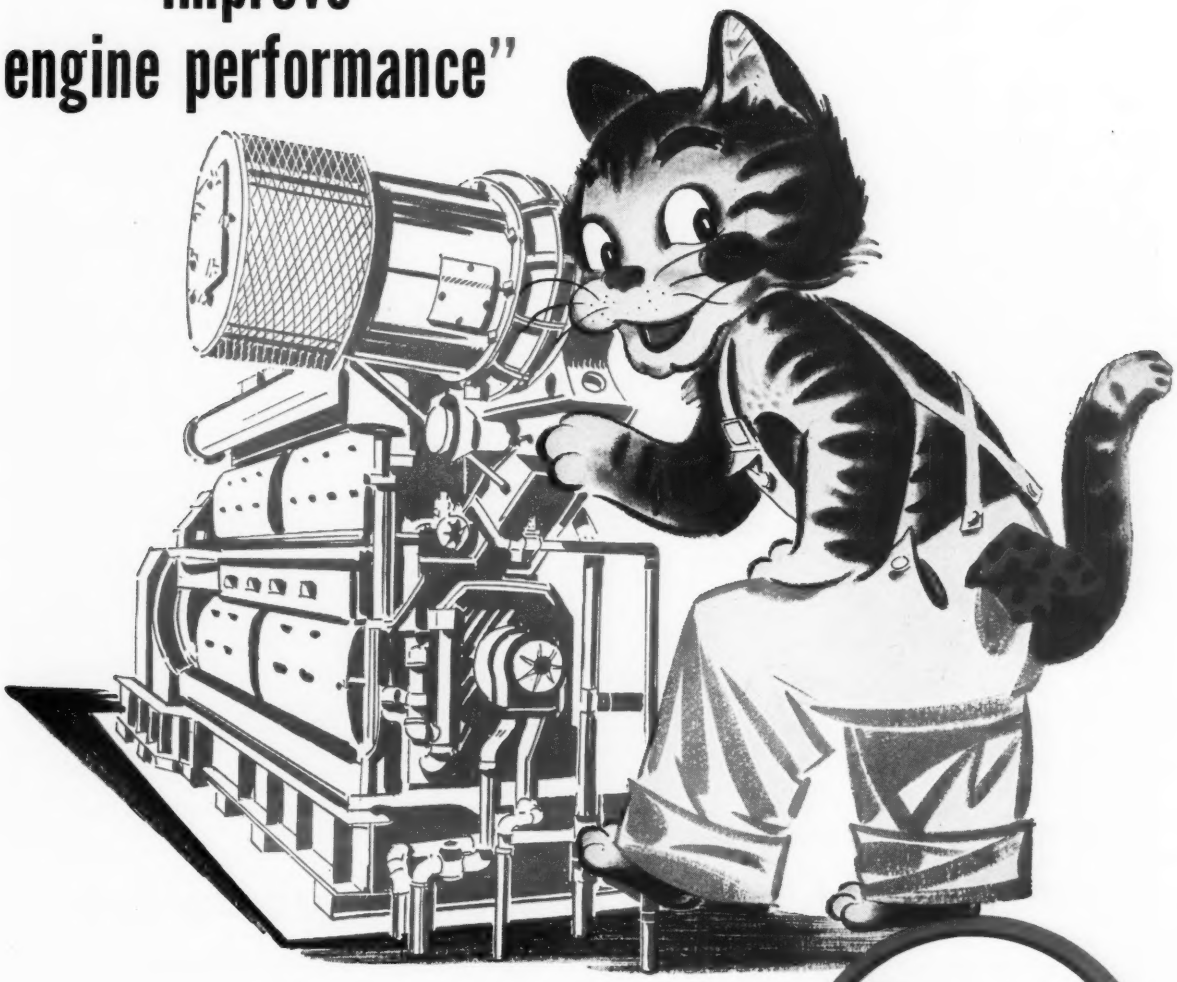
"Tycol Diesel Oils assure free rings improve engine performance"



Certainly! Tycol Diesel Lubricants resist sludging, gumming and carbonization. They are made from specially refined, high quality bases, and offer outstanding stability. They have high resistance to heat and decomposition. They help diesels operate continuously . . . with maximum efficiency . . . and lowest maintenance costs.

There is a Tycol Diesel Oil scientifically engineered for every Diesel application – from high-speed units for industrial, railway and marine uses where a heavy-duty or detergent oil is necessary to low speed Diesels where a non-additive lubricant can be used.

Want to learn more about these fine oils – engineered to do the job better, at lower cost? Call or write your nearest Tide Water Associated office today.

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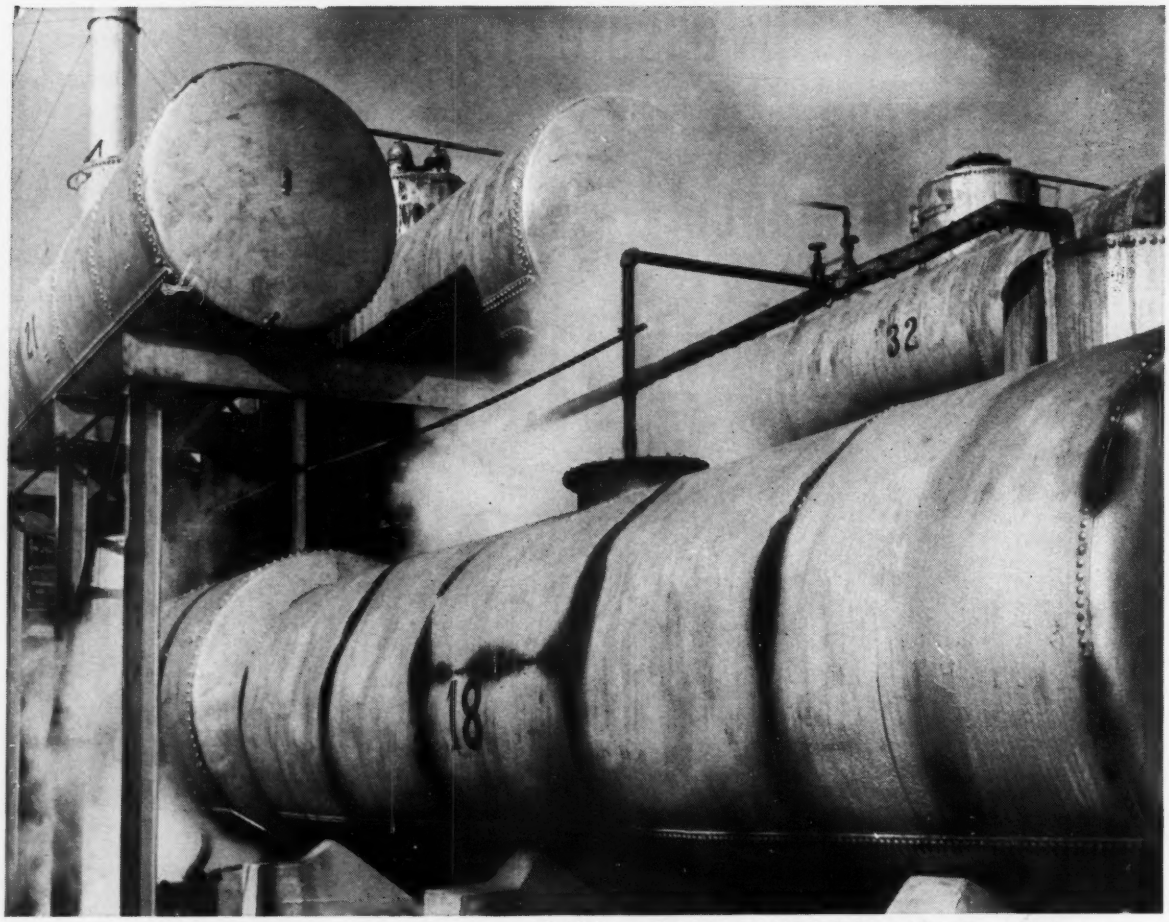

Not half a world away . . . but right in the heart of the industry. In this battery of heated tanks, newly made Palmoshield is stored, ready for immediate shipment.

Buy it as you use it...

Palmoshield service eliminates stockpiling

Threats of war . . . shipping uncertainties . . . materials shortages. These headaches fade away when you use Palmoshield as the essential lubricant in your rolling operations.

For Palmoshield is an all-American product made from freely available domestic materials right in the heart of the steel industry. As a Palmoshield user, you are not dependent on overseas shipment from foreign-controlled sources. So you need not tie up space or funds in stockpiling.

A call to Ironsides in nearby Columbus brings overnight shipment in emergencies. Where requirements are established, a delivery schedule can be set up which assures your receiving Palmoshield on a regular basis.

Now tested and proved in commercial use
Within a few months Palmoshield has been accepted by most major steel companies for on-the-job test runs or actual mill operation. Results substantiate findings in three years of pilot tests:

—that Palmoshield duplicates every chemical characteristic of imported palm oil.

—that it looks, feels, acts, handles like the imported product.

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—that it is superior to palm oil in being subject to exact chemical control. You can specify free fatty acid content to ½%—and get it.

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...A "CREW" of NEVER-FORGETTING OILERS

Bliss Press equipped with 24 feed Manzel Model 25 Lubricator

Why it pays to select Manzel Lubricators

THEY CORRECTLY LUBRICATE EACH POINT
Separate pumping units for each wearing point.

THEY LENGTHEN THE LIFE OF MACHINERY
Perfectly engineered lubrication adds years of trouble free service.

THEY REDUCE "DOWN TIME"
Machinery is lubricated while in operation.

THEY CUT OIL CONSUMPTION DRASTICALLY
Accurate metering of oil saves up to 90%.

THEY PUMP AGAINST HIGH PRESSURES
Special models available for most requirements.

With built-in Manzel Lubrication you *know* that every wearing point is always receiving *exactly* the amount of oil it needs. 'Manzels' don't forget or make mistakes. As a result Manzel-equipped machinery operates efficiently for many more years.

Manzel Force Feed Lubricators are furnished as standard equipment on many of the leading makes of presses, engines, and other machinery. Or they can be installed on your present equipment. They may be synchronized by lever or rotary drive, or operated by a separate electric motor.

We will gladly have a Manzel lubrication engineer submit recommendations without obligation. Just write...

Manzel

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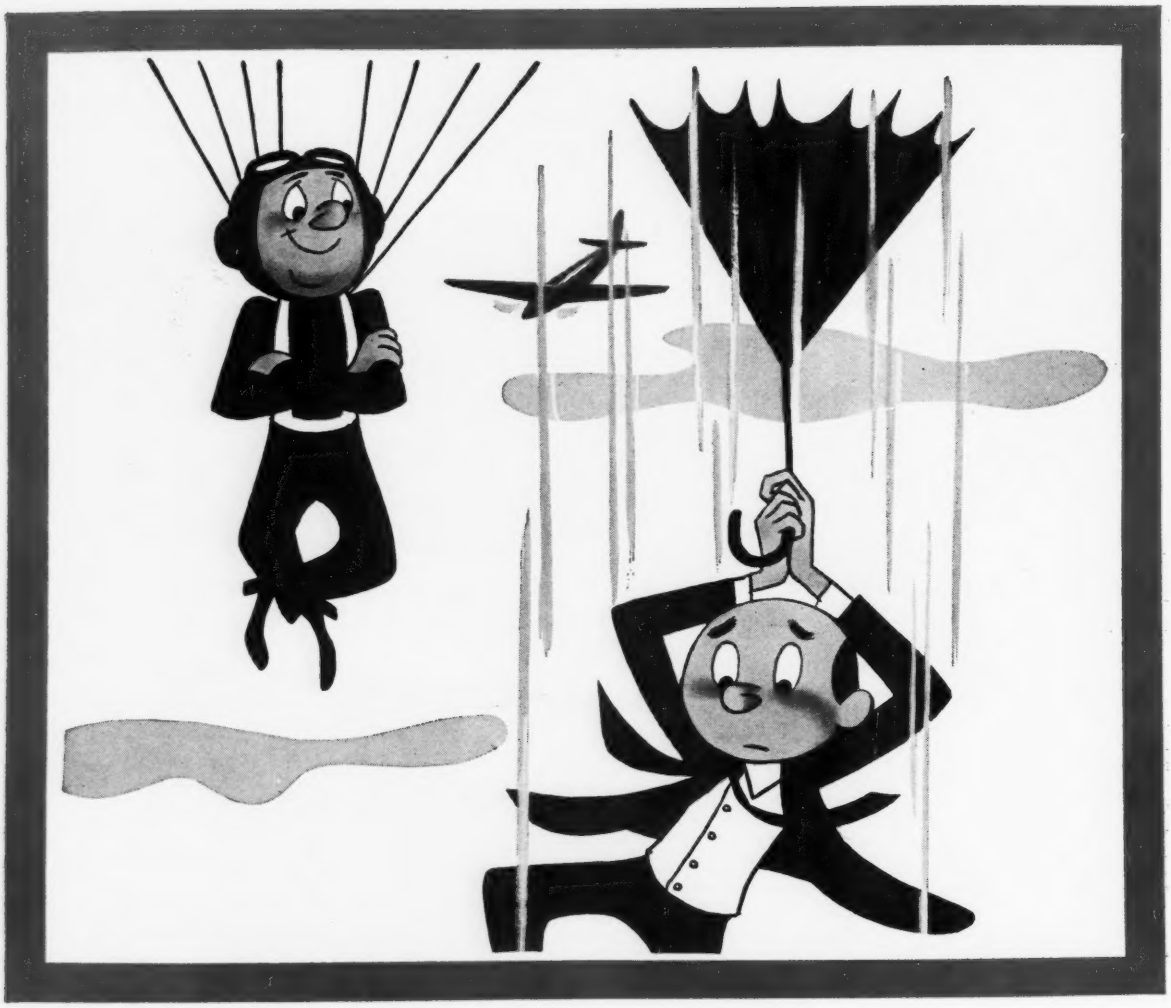

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STOP downtime, costly repairs on HYDRAULIC EQUIPMENT

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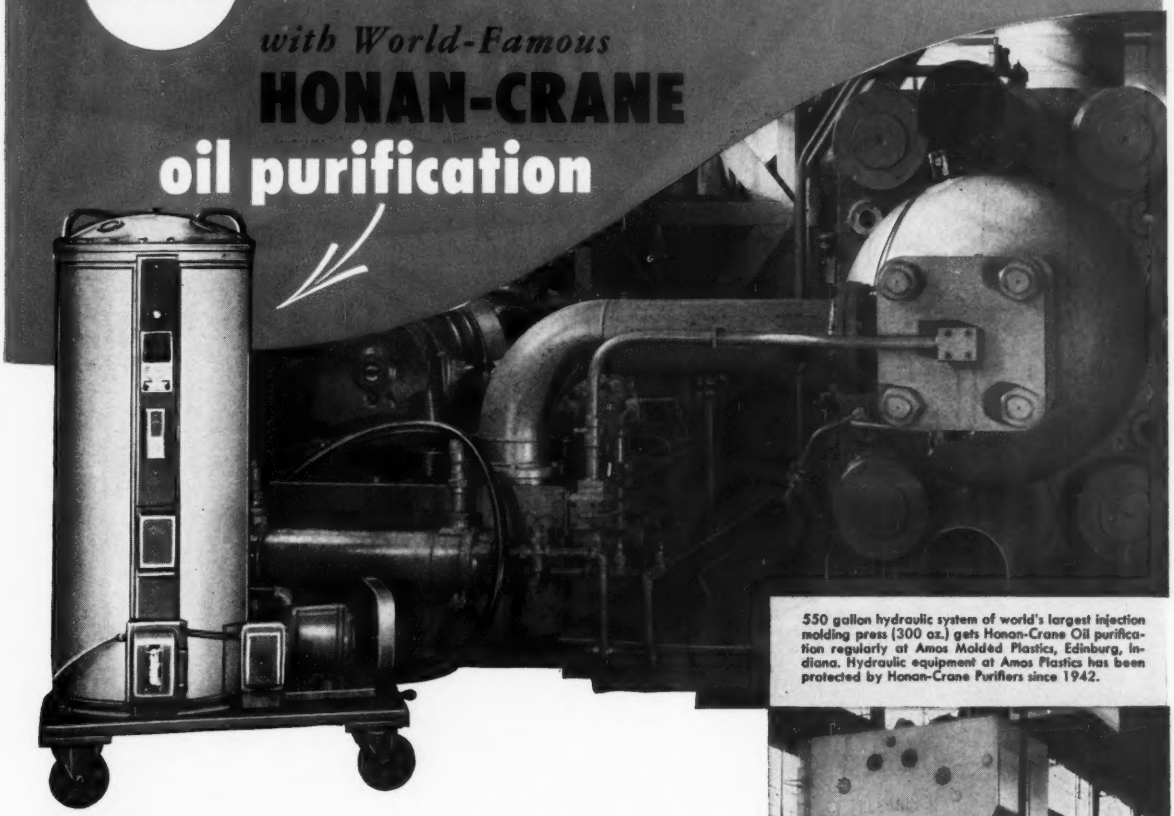
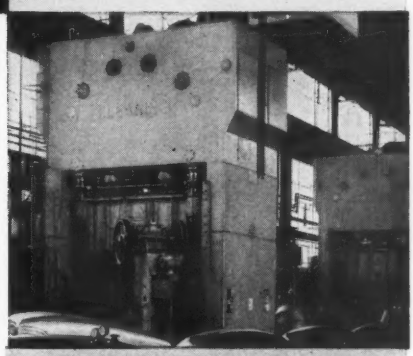
HONAN-CRANE oil purification

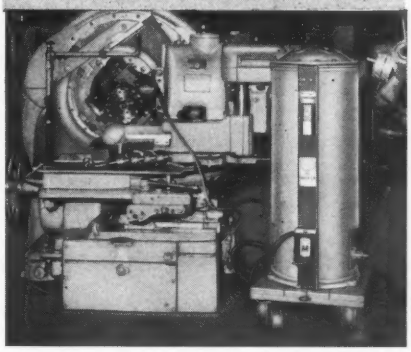


550 gallon hydraulic system of world's largest injection molding press (300 oz.) gets Honan-Crane Oil purification regularly at Amos Molded Plastics, Edinburg, Indiana. Hydraulic equipment at Amos Plastics has been protected by Honan-Crane Purifiers since 1942.



ABOVE: Honan-Crane Purifiers maintain clean oil for battery of giant hydraulic presses in prominent automobile body-parts plant.

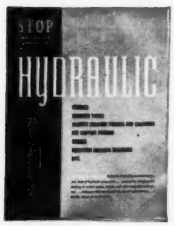
BELOW: Honan-Crane Purifier maintains clean hydraulic oil in 80 to 90 metal working machines at International Harvester Co., Fort Wayne, Indiana.



70% of Trouble on Hydraulic Equipment Is Caused by Oil Contamination and Failure

Honan-Crane Purifiers prevent trouble before it starts in hydraulic installations by keeping oil clean and free from damaging contamination. When used to replace ineffective methods or where no purification has been practiced previously, 50% reduction in hydraulic maintenance costs and 4 to 5 times the former safe oil life are common experiences.

Honan-Crane Purifiers prevent excessive wear of hydraulic pump parts . . . prevent clogging and sticking of control valves, pistons and other hydraulic mechanism . . . greatly extend the safe-use life of hydraulic oils Specify Honan-Crane Oil Purification for your hydraulic equipment. Proven by years of dependable service throughout the world . . . there's no reason to settle for less!



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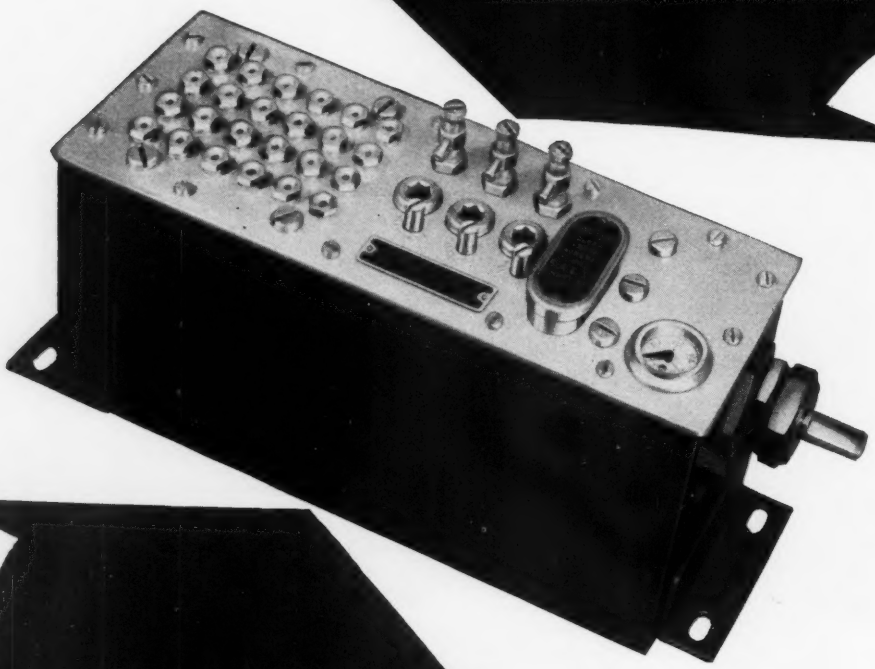

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MEASURED FEED DROP BY DROP FED UNDER PRESSURE!

MACHINE performance is in direct relation to the quality of the oiling system! And that's why builders of America's finest machine tools, work engines and compressors specify Madison-Kipp "Fresh Oil" Lubricators as original standard equipment . . . because they provide the most dependable oiling system ever developed . . . measured feed, drop by drop, fed under pressure. There are six models to meet almost every application requirement. Illustrated is the Model FD. Please address all inquiries to the home office in Madison, Wisconsin

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Gives ALL THESE PLANT SAVINGS:

1. **Extends TIME between greasings**—lasts longer . . . stays in bearings longer.
2. **Low-cost application**—fewer servicings and *only the one grease* to handle.
3. **Simple inventory**—Shell Alvania Grease replaces up to 20 brands formerly required.
4. **Better protection**—against heat, cold and moisture.
5. **Greater safety**—less chance of applying the wrong grease!

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1. **Higher mechanical stability** than any conventional grease at operating temperatures.
2. **Pumpable at low temperatures**—even in unheated storage.
3. **Stable at high temperatures**—superior to the best "soda" greases.
4. **Impervious to water**—excellent resistance to washing out.
5. **Longer service life**—reduced consumption.

The "MILLION-STROKE" Industrial Grease!

A grease that will stand 100,000 punishing strokes of the ASTM Work Tester has been considered a superior lubricant.

In a deliberate attempt to break down Shell Alvania Grease, *on the same tester* the run was extended...200,000 strokes...300,000 strokes . . . 500,000 strokes! Finally, at one million strokes the test was discontinued, because this grease *would not break down*—it was still a fit lubricant both in appearance and consistency.

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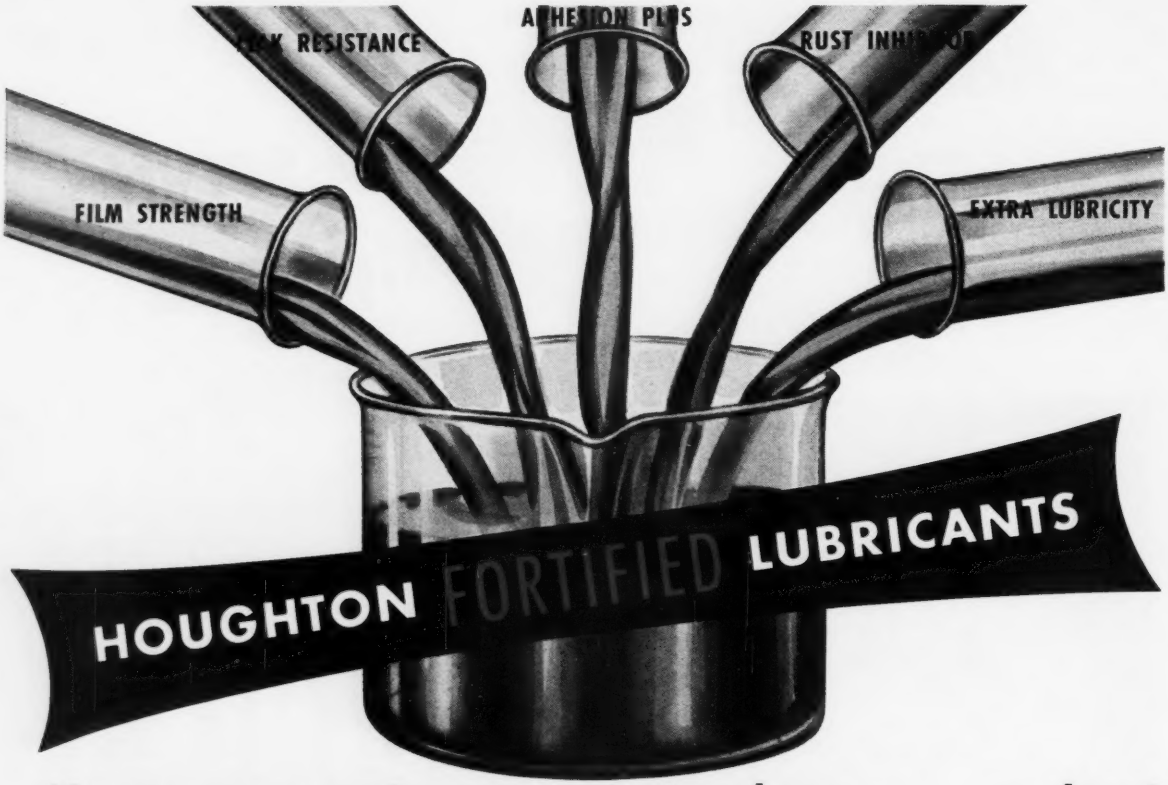
SHELL®

SHELL ALVANIA . . . The "MILLION STROKE" Grease



Keep your equipment running longer . . . on less!

It's the extra properties we add to a top-notch base oil that enable Houghton lubricants to give you superior performance that's been proved under severest conditions.

They're *fortified* with film strength great enough to hold up under extreme demands. They're given additional adhesion so they cling tightly to metals. They're given greater lubricity that puts a strong cushion between moving parts. And non-leak properties that reduce the amount of lubrication needed.

Get to know the Houghton line of industrial lubricants—*fortified* to give you more efficient operation and cold cash savings. The performance report on Houghton's "Sta-Put" lubricant is a good example. Our line includes high temperature and E. P. gear oils—ball-bearing and all-purpose greases—hydraulic, air compressor, spindle and cylinder oils.

For complete information consult the Houghton Man or get in touch with E. F. Houghton & Co., Philadelphia 33, Pa.

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No. 13	96	26	70
No. 15	80	18	62
No. 16	96	73	23
No. 17	144	55	89
TOTAL	776 qts.	211 qts.	565 qts.

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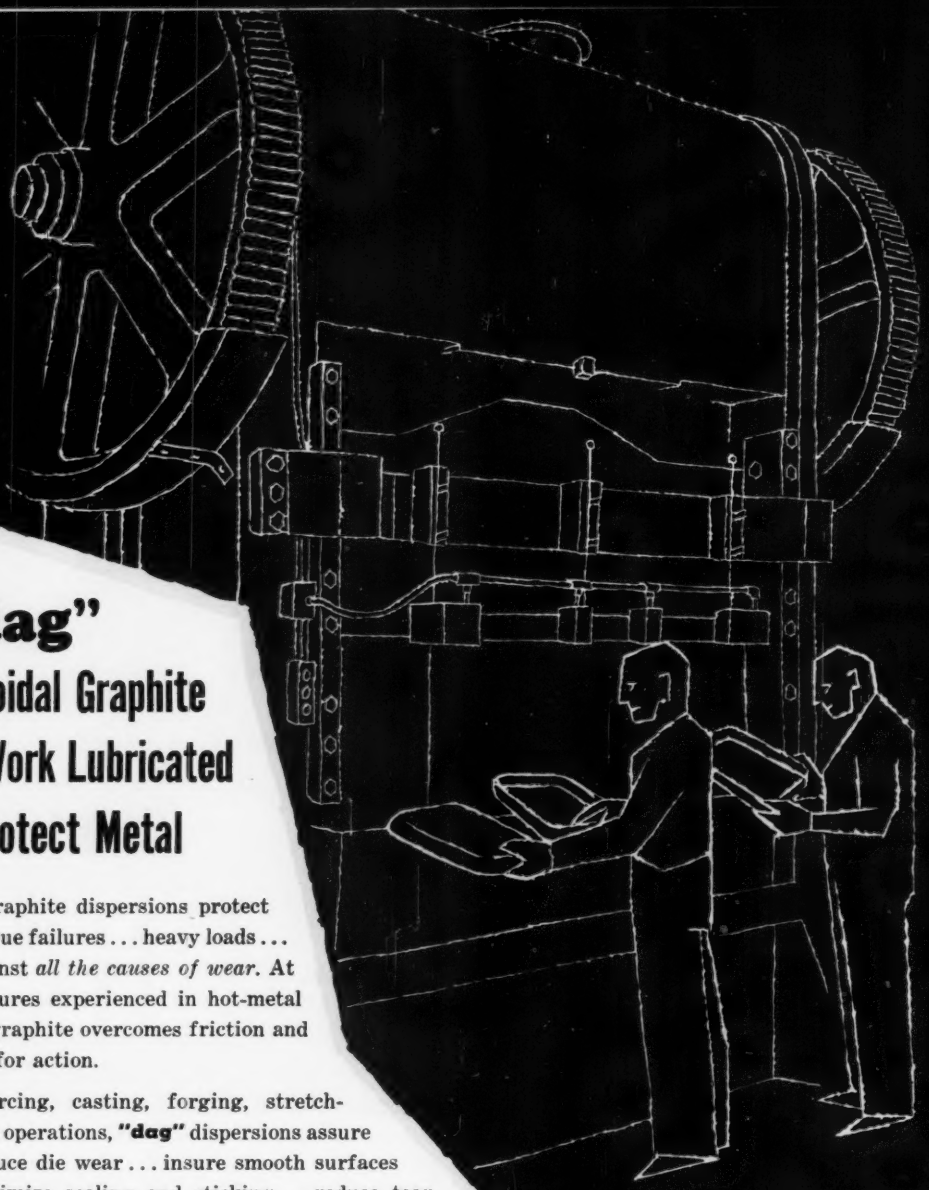

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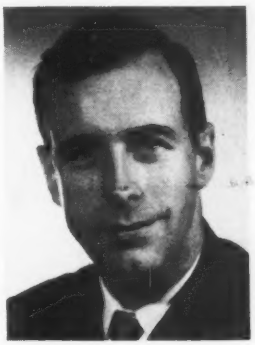
PRESIDENT'S MESSAGE



M. Eugene Merchant, Assistant Director of Research, The Cincinnati Milling Machine Co., has been active in the science and practice of lubrication engineering ever since the completion of his undergraduate studies.

He was born in Springfield, Massachusetts, May 6, 1913, and obtained his Bachelor of Science degree in Mechanical Engineering from the University of Vermont in 1936. Graduate study in the basic sciences was carried out at the University of Cincinnati, under a fellowship provided by The Cincinnati Milling Machine Co., for which the Doctor of Science degree was awarded in 1940.

Dr. Merchant has conducted a great variety of basic and applied research in the fields of friction, lubrication and cutting fluids, as well as in the field of the machining of metals, and has published numerous writings on these subjects.

He is an active member of many technical societies including ASLE, ASME, ACS, APS, OSA, SESA, AAAS, and ACA. In ASLE he has served as a Director, as Mid-Western Regional Vice President, and as Vice-President at Large, as well as being the first Chairman of the Cincinnati Section. He organized the system of Technical Committees now functioning in the Society and served as Chairman of the General Technical Committee until his election to the Presidency.

Dr. Merchant married the former Helen S. Bennett of Baltimore, Maryland, on August 4, 1937. They have one son and two daughters and live in Mariemont, Ohio.

As the American Society of Lubrication Engineers enters its eighth year, a new and important page in its young but vigorous history is begun.

News of the resignation of Mr. W. F. Leonard as Secretary of the Society, and of Mrs. Patricia Leonard as Managing Editor of LUBRICATION ENGINEERING, necessitated by circamstances beyond the control of either of them or of anyone, was received with regret by the membership earlier this year. The Board of Directors in accepting these resignations, expressed their commendation and deep appreciation to Mr. and Mrs. Leonard for their faithful service to the Society and their very considerable contributions to its growth and advancement.

It is with a great deal of pleasure that we announce the appointment of Mr. William P. Youngclaus, Jr., as Administrative Secretary for the Society, with headquarters in the National Office. Mr. Youngclaus, as a longtime member of the Society and an experienced lubrication engineer, brings both an excellent background and fine vigor and enthusiasm to this important position. Likewise it is with pleasure that we announce the appointment of Mr. Charles Kluge as Editorial Assistant in the National Office. Mr. Kluge's efficient and enthusiastic work in handling many of the details of this year's annual meeting will be recalled by many who were in attendance there. Details about the background of both of these men are included in this issue of LUBRICATION ENGINEERING.

Not only has the beginning of this eighth year seen changes in the staff of the National Office, but, as will be noted, the masthead of LUBRICATION ENGINEERING now carries a new name. Dr. S. K. Talley has accepted the active Editorship of this Journal. Dr. Talley is well known for his outstanding work and abilities in the field of lubrication; his excellent service on the Editorial Committee during the past year contributed much to the technical excellence of the Journal, and we are proud to welcome him to its Editorship. Prof. Burgess Jennings, who guided the Journal from its very inception, continues as Consulting Editor, so that his valuable background of editorial experience will continue to be available to the Society.

An important and significant innovation this year is the holding of a National Symposium on lubrication fundamentals at the time of the Centennial of Engineering in Chicago, on September 8-9. Frankly, this is an experiment to determine whether a Fall Symposium, devoted to some phase of lubrication engineering, should be made an annual event by the Society. We take this opportunity to extend to all who are interested in lubrication, in any of its multitudinous phases, a warm invitation to meet with us in Chicago for this outstanding event.

The emphasis for the year ahead might be keynoted by the word "service"—increased service to members and increased service to industry. One very important field of service which will receive emphasis this year is that of education. The Society is sponsoring a two-week summer course in lubrication engineering at Georgia Institute of Technology, June 15-27, and a shorter course at Purdue University, June 9 and 10. In addition assistance has been given to Massachusetts Institute of Technology in preparations for their second summer course in lubrication engineering, to be given June 23 to July 3. The Education Committee of the Society is playing an important part in guiding these and other educational activities.

As its eighth year begins the American Society of Lubrication Engineers rededicates itself to serve industrial America to the utmost of its collective capabilities.

M. EUGENE MERCHANT.

GREASE
*lubrication of ball bearings**

BY LELAND D. COBB, *Mgr. of Research, New Departure Div., Gen. Motors Corp., Bristol, Conn.*

The subject of grease lubrication for ball bearings is too broad a subject to be totally covered in one paper, due to multiplicity of bearing designs and conditions under which the bearing must operate. Therefore, this discussion will lightly cover the special bearing operating conditions, such as high temperature, high speed, and extra heavy loading and, for the most part, will concern normal operating conditions. Also, this discussion will be limited to grease-lubricated, integrally sealed bearings, noting the fact that much of this information on integrally sealed bearings is also applicable to grease-lubricated bearings having integral shields or external nonintegral closures. Since it is of primary interest to a ball bearing manufacturer to obtain the best possible greases for use in antifriction bearings, this paper is also limited as to how commercially available grease works in ball bearings and not how to build better greases.

As everyone is possibly not acquainted with integrally sealed or shielded bearings, it is in order to take some time to present the design and history of these types of bearings.

The first double-sealed, factory-lubricated bearings were made for use in electric motors in an effort to reduce bearing mounting costs, to keep contaminant from the bearing during assembly handling, to protect the bearing against corrosion, to assure good sealing of the bearing against contaminant and retention of lubricant in bearing, and to insure that a good clean lubricant was used to obtain maximum bearing life. Seal development work was started in 1926, and the design has progressed to that of the present day, as shown in Figure 1.

Fig. 1. Present-day ball bearing seal design.

These bearings may be made to special ring widths or standard widths, seals on one or both sides or combinations of seals and shields. The commercial prospects of this type of bearing were quickly recognized and accepted by industry so that at the present time all the ball bearing manufacturers have developed sealed bearings of various designs for use in every conceivable type of application.

During the first few years of sealed bearing production, the major difficulty was to obtain a grease which would remain in the restricted space in the sealed bearing and still give good bearing life under normal speeds and loading. As it was impossible to obtain lubricants with what was considered the necessary characteristics, the plant laboratory finally developed such a grease, the formula of which was turned over to the major grease producers for quantity grease production. This was the start of highly refined greases which are now made in large quantities and of various analyses for ball bearing usage. These new greases have allowed the use of both integrally sealed and nonintegrally sealed ball bearings in ever-extending applications involving high speed, very heavy loading and high temperatures, and have allowed the use of grease in lieu of oil, thus relieving and simplifying many design problems.

The extension of the use of greases as ball bearing lubricants has vastly increased the bearing makers' problems, as the lubricant generally is the determining factor of bearing life. Tests indicate that when bearings are operated under load factors of .75 or less (i. e., load factor f = manufacturer's catalog-rated load divided by the actual operating load or so-called pay load, and it is seen that as the pay load increases, f decreases in value), bearings fail due to metal fatigue, whereas, as lighter loading with f above .75, lubricant life governs the bearing life. This is a very general statement and will vary depending upon the bearing application and the type of grease.

Although it is an impossibility to investigate every grease that is produced, any grease which apparently has the possibility of fitting into some special requirement or that could be used as a standard for normal applications, considering storage life, protection of bearing parts during storage and operation, bearing life, torque, noise generation, heat generation, ability to stay in bearing, and handling by production personnel, is thoroughly tested. Cost of the grease is also a major consideration, except for special-purpose greases. The results of these tests are not published but are used as an

* Paper presented before the Boston Section of ASLE. Sponsored by ASLE Technical Committee on Bearings and Bearing Lubrication.

aid in recommendations to the customer; and, in the end, it is the customer's decision as to what grease lubricant he desires to use. If the recommendations are not in agreement with the desires of the customer, the customer will either be informed that the bearings will not be supplied with the requested lubricant or that the use of a given grease will be at his own risk and that he will assume full responsibility if his selection does not perform satisfactorily.

When a new grease lubricant becomes available, a sample is first obtained and the plant laboratory runs a preliminary chemical analysis and physical screening test.

If these results are satisfactory, trial runs are made to enable graphs to be plotted of speeds versus temperature and load versus temperature for actual sealed bearings, noting the ability of the lubricant to be retained in the bearing, bearing operating torque, temperature generation and condition of grease after test runs. In general, the effect of bearing speed on the life of most greases used in ball bearings is not great, but the effect of load on grease life is appreciable. Induced temperature due to the above variables is responsible for most of this detrimental effect on grease life. Simultaneously, corrosion tests are conducted to determine the protection this grease gives to standard bearing rings. If the grease passes these tests, bearing life is next determined, with the subject grease as a lubricant under a load factor, $f = 1$ (based on catalog rating, as explained in an earlier paragraph) at 3000 r.p.m., with self-induced temperature. In addition, bearings with subject grease and running at 3000 r.p.m. are tested with ambient temperature of 250 F. and in certain instances at 300 F., under a condition of so-called no load which, in reality, could amount to approximately 25-pound radial load, due to the weight of test equipment parts acting on the bearing. In other instances, the test may be in the actual apparatus in which the customer intends to use it.

A standard test machine for grease testing, as shown in Figure 2, allows testing of 0 to 7 bore bearings (10 to 35mm.) under any kind or combination of loads at speeds of 360 to 10,000 inner ring r.p.m. at room or controlled ambient temperatures up to 300 F. Machines of this type are composed of twelve to sixteen stations, each station accommodating four test bearings. The bearings in each station, as shown in a close-up view, Figure 3, are mounted in housings and on shafts with ABEC 1 fits. The two center bearings are individually spring loaded radially and the end bearings carry the reaction. The center bearings may also be thrust loaded by means of Belleville spring washers with a screw and nut device. End bearings can only be run under radial load. Thermocouple wire, fixed to each test bearing outer ring at the heaviest loaded section, connects with a recorder which registers the operating temperature every half hour and shuts down the machine if any bearing exceeds a previously set temperature, indicating which bearing has exceeded the temperature limit.

When required, a more flexible type of testing machine, which is normally used to test bearings with oil lubrication, can be readily used for testing grease-lubricated bearings. Figure 4 shows a view that a person would see looking down from above into an individual

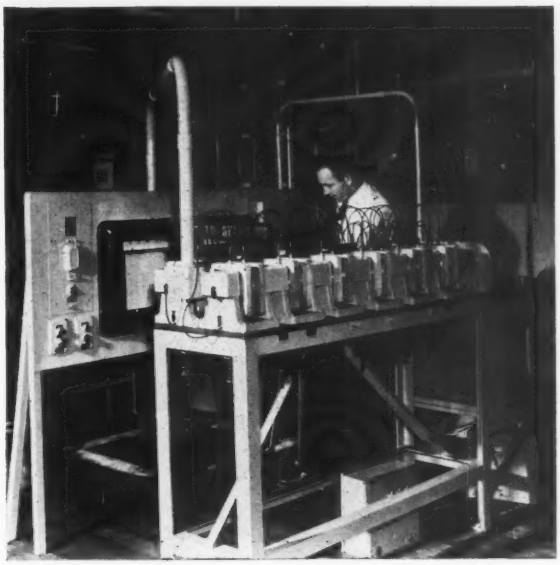


Fig. 2. Standard machine for grease testing ball bearings.

station of this so-called Cadillac-type tester, composed of six to eight stations, with four bearings per station. The individual station load is applied with a dead weight acting through a system of levers to the two center bearings in the station with the end bearings taking the reaction. Stations are connected by flexible couplings. Various sizes of bearings can be tested by changing adapters, spacers, etc. End bearings operate only under radial load, whereas, center bearings can be subjected to any load combinations. A variation of this basic machine has been made by insulating it and furnishing it with suitable temperature controls, and is being used for investigation of test bearings running at temperatures of +50 F. to +500 F.

A very flexible type of spring-loaded bearing tester is shown in Figure 5. On this machine test bearings are spring loaded for axial, radial, or combined loads, and these loads and/or speeds can be cyclic. Also, ambient temperatures of zero to +250 F. can be obtained. These machines are also useful for outer ring rotation and investigations on misalignment of bearing rings. Easy access to the bearing under test also allows controlled contaminant tests and stroboscopic study of the behavior of bearing parts under various conditions of loads, speeds, lubrication, contamination, fits, etc.

The Physical Testing Laboratory has this standard test equipment with capacities ranging from 300 to 10,000 rpm and from room temperature to +500F. and for any desired steady radial or thrust bearing loading at the rate of 2,296,320 bearing test hours per year. Of this, 985,920 hours per year are being operated on grease-lubricated bearings and the balance, on oil lubrication. Oil lubrication is used for production bearing endurance checks and basic processing and/or material tests.

From the test results on a given grease run in three or more standard sizes of bearings, graphs and tables

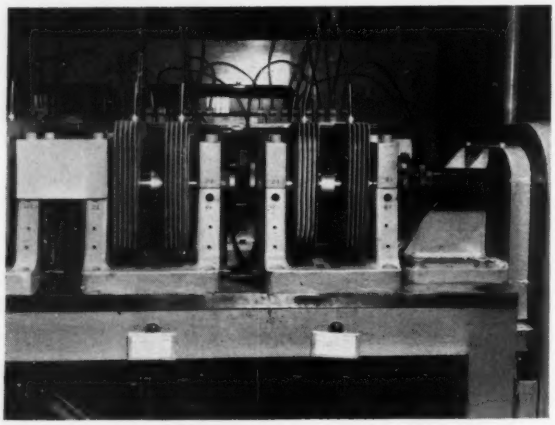


Fig. 3. Close-up showing four stations in grease testing machine.

can be developed showing the effect on bearing life created by outer race temperature versus bearing life, speed factor, load factor, and type of loading. From these graphs and charts, bearing life, as determined by grease life, can be predicted for any speed, load or ambient temperature condition to which ball bearings are usually subjected. At the present time tests of sufficient magnitude to forecast bearing life with grease have only been conducted on the grease used as a production standard. Results of tests and charts necessary to forecast the life of bearings packed with this grease were published in "The Institute Spokesman," No. 7, Vol. 14, page 10, dated October, 1950. This forecasting method has been encouragingly accurate and has created considerable interest. It should be pointed out that results may not be usable in some special design seal bearings where heat may be generated by seal drag, so as to affect the normal operational characteristics of the grease. Such seal designs have a definite limiting speed if grease life is to be considered. It should also be pointed out that operating conditions used in forecasting must be factual and not some hypothetical conditions, or the forecaster will obtain some very misleading results.

The aforementioned matter is very general and useful as a production tool, but the engineer wonders about the mechanics of grease lubrication and the effect of grease volume and placement with respect to the working surfaces of a ball bearing. While investigations are by no means complete, the following determinations are in the process of being made:

1. Effect of grease volume on bearing life
2. Mechanics of grease lubrication
3. Temperature encountered between balls and separator where sliding friction exists, and between ball and races where rolling, plus sliding friction exists.
4. Placement of grease relative to working areas

1. Grease Volume versus Bearing Life

From an engineering standpoint, in evaluating the effect of grease volume on bearing life, one must forget the commercial aspects such as space requirements restricted by given manufacturing designs, cost, etc., and deal with the fundamental principle. One must, however, consider operating temperature, bearing loading and internal bearing design. From investigations on two channel-type greases used extensively as standard lubricants in standard ball bearing designs of such a nature as to enable usage of a maximum amount of grease lubricant, indications are that at 250F. measured on the outer ring outside diameter with temperature generated by light bearing loading, normal speed and controlled ambient temperature of 250F., increasing available grease supply increases bearing life where grease life is the criterion of bearing life. In these tests the volume of air space between lubricant clinging to the balls and separator and the static lubricant in the chamber formed by the seal, was maintained constant for all grease volumes to diminish variations due to grease churning and the resultant heat generation. The extra space for static lubricant storage was obtained by extending the seal outer dimensions, to cover ever-increasing increments of the outside diameter of the inner bearing ring.

These tests were conducted on a basic six-bore (30mm. ID.) bearing operating at 2000 inner ring rpm, 50 pounds radial load and 250F. It was noted that the bearing life increased considerably with added grease volumes of appreciable magnitude under stated test conditions.

It is not known how grease volume affects bearing life under normal operating conditions, as this phase of test has now progressed for four years with minimum grease volume, no load, 3000 inner ring rpm, at room temperature, with no failures as yet. Also, there are some field tests under very similar conditions where bearings have run over twelve to fifteen years with no failure attributed to grease lubrication. Tests on the effect of grease volume under heavy loading have just been started with no results to report as yet. From available data it can possibly be concluded that where a bearing lubricated with a grease made with petroleum oil is operated at temperatures of, say, 200F. to 300F. due to ambient or self-generated temperatures, a grease volume greater than that normally found in a standard sealed or shielded bearing is beneficial in extending life.

At lower than an arbitrary value of 200F. or thereabouts, it is probably that the bleeding rate of the usual petroleum-type grease used to lubricate and to protect sealed bearings is so slow that the additional oil from the increased volume of grease, especially the oil from added grease spaced most remotely from the bearing balls, separator and races, probably fails ever to reach the operating portion of the bearing, making the added lubricant of little benefit. It is often noted in ball bearings running under normal temperatures (75 to 115F.), speeds (100 to 4000 rpm), and loads (catalog rating or less) that the lubricant in the working portion of the bearing, after extended operation, has become oxidized or changed its composition, so it will no longer lubricate. The accompanying damage to bearing componets may be considered to be due to lack of lubrication, even though the grease in the storage or nonworking portion of the bearing is in fairly good condition. Use of a

grease having greater bleeding characteristics possibly would allow greater utilization of available oil in the added volume of grease, but oil from such grease is generally lost faster from sealed bearings, as compared with greases of lower bleeding rates, and bearing life is impaired where extended operation under normal conditions is desired. It is considered, therefore, based on actual usage of sealed ball bearings, that the added cost of building in the extra grease space for bearings used in most commercial applications is not warranted.

2. Mechanics of Grease Lubrication

Grease is basically composed of a soap which acts as a thickener, holding the lubricating oil, and it releases this oil under certain conditions for use as a lubricant. No attempt will be made to state what part the soap or binder plays in the actual lubrication. The type of grease used in sealed or shielded ball bearings is generally not considered to be of a bleeding type, but is rather the relatively stiff channeling type which does not readily change position in the bearing chambers, except by mechanical agitation of the rotating balls and separator, or the portion of the rotating rings it may contact. To obtain an indication as to grease movement, a six-bore bearing (30mm. ID.) with removable seals was packed full of a standard lubricant and run under 50 pounds radial load, 3000 rpm, and 250F. ambient temperature, until the temperature of the bearing, as measured on the bearing outer ring, became stable. The bearing seals were then carefully detached and a portion of the grease from around the balls and separator was carefully removed, so as to prevent any mechanical exchange of grease from the balls, separator or races into or from the seal chamber, when the seals were reassembled onto the bearing and the bearing run under the aforementioned test conditions. This was checked several ways, and when the test engineers were satisfied that there was no visible change, one seal chamber was removed and all of the grease was removed from it.

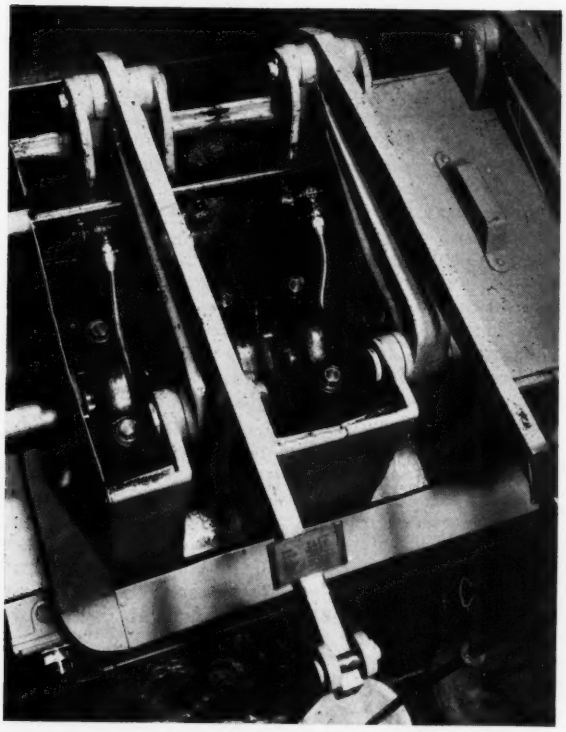
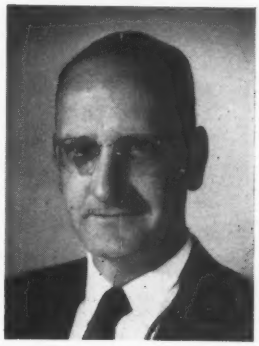


Fig. 4. Close-up showing one station of Cadillac-type bearing testing machine.

A thin film of cetyl chloride was synthesized using, with slight modification, the method described by Norris and Taylor[1]. This material, tagged with radioactive chlorine, was laid into the most remote face of the seal from the ball race and was frozen into place by the use of dry ice. The grease just previously removed from the seal chamber was reinserted and smoothed off for correct clearance from rotating bearing parts. The bearing was then run for 500 hours at 3000 rpm, 50 pounds radial load, and 250F. ambient temperature, as measured on the outer bearing ring and, with the bearing in a static condition, the migration of the tagged material was charted by counts per minute for each individual seal, both assembled to and disassembled from the bearing. Readings were also taken of the bearing itself when the seals had been removed. Although there was no visible movement of the grease, the count on the tagged material demonstrated migration of tagged material in substantial quantities from one seal through the operating bearing into the other seal under the aforementioned test conditions. Periodic checks showed continued changing of count in different portions of the bearing as the test progressed. This test is being repeated, not only with all the original conditions, but also under normal operation at room temperature, as there is some question as to whether the oil in the grease flowed or just the tagged cetyl chloride. In the next test the oil in the grease will be tagged.[2]



Mr. Cobb graduated from Pratt Institute in 1928 (Electrical Engineering) and has since been in the employ of the New Departure Division, General Motors Corporation, with the exception of 1942 and 1943 when he was Assistant Chief Engineer at the Draper Corporation, Hopedale, Massachusetts. At New Departure, he has served in a number of capacities including Product Design Engineer, Physical Test Engineer, Executive Engineer, Assistant to General Manager and presently Manager of Research and Development. As a result, he has covered practically all phases of engineering concerning ball bearings and their uses in all types of applications.

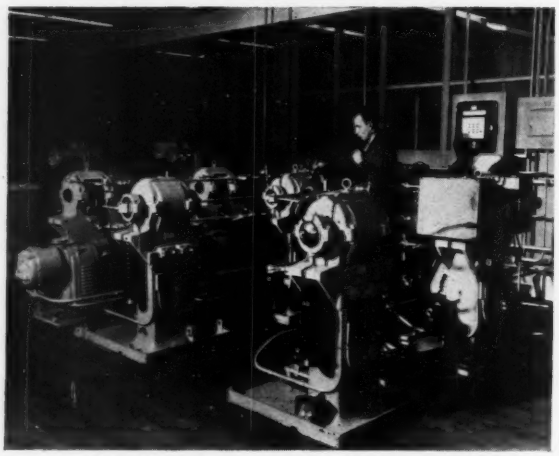


Fig. 5 Spring-loaded type bearing testing machines.

If it can be assumed that the theory of oil migration is correct, then it can be assumed that greases of normally considered nonbleeding types do bleed oil of sufficient magnitude to lubricate adequately ball bearings, and this oil flows from one side of the bearing chamber to the other, even though the bulk of visible grease is static. Phenomena causing this flow are still under study.

3. Temperature Existing Between Balls, Races and Separators

No direct method has yet been devised to measure the temperature of the lubricant and the bearing surfaces at the contact areas. Various methods have been tried and are satisfactory when the bearing is stationary, but when the bearing is revolved, the commonly used magnetic bearing materials set up electric fields which influence any electronic measuring device.

4. Positioning of Grease with Respect to Bearing Working Areas

The initial placement of grease in regard to working areas of a ball bearing is not critical as long as the lubricant can flow into the working area and excess lubricant in the working area can be expelled, thus eliminating excessive churning. Tests show no material difference in leakage by seals, bearing running, starting torque, or level-off temperature, whether the grease opening up new fields for grease-lubricated ball bear- is packed in from only one or both sides, provided the total amount of grease placed in the bearing is equal under either placement condition.

Design requirements by the Armed Services are ings which are being successfully met due to many new synthetic lubricants and new bearing designs. These are special-purpose lubricants and designs, but their value will be undoubtedly reflected in standard bearings of the future. The silicone grease is one example of a grease which did not show up very well at first, but has now reached the point where, under load factors of $f = 2$ or over, at normal speeds, the life obtained from bearings silicone-grease-lubricated at 250-300 F., is three or four times the life generally obtained with petroleum greases. Two features must be overcome before this grease is used as a standard lubricant. One is excessive bearing torque, which is approximately twice that obtained with the average ball bearing type petroleum greases, and the other is inadequate film strength which now limits the use of silicone greases to maximum loads of approximately only half of catalog ratings ($f = 2$), if any appreciable life is desired from the bearing. The term "film strength" is used here to denote the ability of the lubricant to prevent metal-to-metal contact between the balls and races.

In some instances, grease-lubricated ball bearings are used to support grinding spindles operating at 8750 inner race feet per minute which, for a three-bore bearing (17mm.) is 35,000 r.p.m. Many of these spindles, using open bearings, but permanently grease lubricated with no means of relubrication, have been operating for over three to five years or longer, without failure on production equipment, which is possibly equivalent to the life obtained with many oil-lubricated spindle bearings.

Most of these spindle bearings use the nonmetallic type of separator which, because of lower gall characteristics, is not as critical to lubrication as the standard steel type of retainer. The maximum temperature at which nonmetallic retainers will function without charring is about 280 F. for the linen-base phenolic type and approximately 400 F. for the glass-melamine type. Metallic separators have been developed which will withstand the high speeds and temperatures requested by the Armed Services. For example, one turbine installation is operating under pay load conditions with grease-lubricated, four-bore (20mm.) bearings at 250-360 F., 40,000 inner ring r.p.m., 10,656 inner race feet per minute and on breakdown test, these ran at 60,000 r.p.m. or approximately 16,000 inner race feet per minute, 250-360 F. The required life of approximately 500 hours for pay load conditions is being approached and, in most cases, exceeded.

These speeds, temperatures and 500-hour life attainments, however, are not great enough to cover demands. This is a challenge to the grease maker to extend the permissible grease operating temperatures and film strength to meet these new designs and allow good life characteristics to reduce cumbersome designs still required for oil lubrication in many installations.

In conclusion, it is brought to the reader's attention that whereas sealed bearings were considered only for lightly loaded, relatively low speed applications a few years ago, the success of this type of bearing, due to ease of application and freedom from service, is now leading designers to endeavor to use them in practically every position requiring antifriction bearings and, as a result, current orders will dwarf any past years' production schedules and new seals are being continually invented and tested along with new lubricants to keep abreast and ahead of the designers' requirements in sealed antifriction bearings.

1. J. F. Norris and B. Taylor, *J. Am. Chem. Soc.* (1924) 46, 253-57.
2. The investigation of the migration of oil in the grease by the use of radioactive isotopes was made by the Vitro Corp. of America, New York City, as an independent check on tests made at New Departure, where migration was investigated by the use of dye and oil versus soap content before and after test for different locations in the bearing, which, while showing a trend, was not as conclusive or as accurate as tests using isotopes.

LUBRICANT CLASSIFICATION*

BY C. A. BAILEY, *Lubrication Engineer, National Tube Division, U. S. Steel Co., Pittsburgh, Pa.*

The classification of industrial lubricants is extremely broad and of vital interest in this twentieth century development of high speed precision machinery. Like all other problems of importance, the issues are controversial and the answers not easily obtainable.

It is not the object of this paper to debate any one of the many issues in standardization of classification, but rather to present a problem as it exists and outline a method of classification currently used as an approach to the solution. It is not suggested that this method is the solution to any other similar problem, but rather a statement of practice. If there had been in existence a classification nomenclature approaching a solution to the problems encountered it would have been adopted in preference to the development of a special method.

The machine age has created the need and recognizes the problem that lubrication, which was once a relatively unimportant item in the realm of rough bearings serviced by hand methods, has now become a specialized branch of engineering involving mechanics, chemistry, and electrical instrumentation. In fact, the chemical compound in the lubricant used in the gears of a cold reduction mill is a prerequisite affecting the design of the length of the mill pinion and type of bearings. These important lubrication applications can no longer be handled by shop expressions often used to describe materials, such as "dope, gue, gunk," or similar street or shop terms.

In the development of compounds, required for the very existence of machines, suppliers have used brand names that either describe the type of the lubricant or describe the machine or application for which the product was intended. Examples that come to mind are:

1. Black oil
2. Engine oil
3. Gear shield
4. Pinion grease
5. Cylinder oil
6. Cup grease
7. Fibre grease
8. Axle grease
9. Neck grease
10. Block grease

Many of these original brand names through many years of usage have become known as a type of lubricant. The newer brand names coined with the development of new products have gone to other categories for unique nomenclature. For example:

1. Stars
2. Sea shells
3. Indian tribes
4. Geology
5. Numbers
6. Initials
7. Letters
8. Machines
9. States or countries
10. Meaningless coined words

The automotive industry represented by the Society of Automotive Engineers was the first to realize the problem and to make its contribution to the public and industry by the SAE numbering system which identifies motor oils' consistency by numbers, without reference to quality. This system is outlined briefly as follows:

*Paper presented at 7th Annual Meeting, ASLE, Cleveland, April 9, 1952.

SAE TABLE

The viscosity of oils included in this classification for use in crankcases shall not be less than 39 seconds at 210 F. Saybolt Universal.

SAE Viscosity Number	Viscosity Range, Saybolt Universal, Seconds at 0 F. Min.	Max.	at 210 F. Min.	Max.
5W		4,000		
10W	6,000 (Note A)	less than 12,000		
20W	12,000 (Note B)	48,000		
20			45	less than 58
30			58	less than 70
40			70	less than 85
50			85	110

Note A—Minimum viscosity at 0 F. can be waived provided viscosity at 210 F. is not below 40 seconds, Saybolt Universal.

Note B—Minimum viscosity at 0 F. can be waived provided viscosity at 210 F. is not below 45 seconds, Saybolt Universal.

Viscosity numbers without an additional symbol are based on the viscosity at 210 F.

Viscosity numbers with an additional symbol *W* are based on the viscosity at 0 F.

In the case of prediluted oils, SAE Viscosity Numbers by which the oils are classified shall be determined by the viscosity of the undiluted oils.

Wherever the SAE Viscosity Numbers are used on prediluted oils, the container labels should show in some suitable manner that the SAE number applies to the undiluted oil.

A Typical Oil Viscosity under the above SAE Ratings

SAE	100 F.	210 F.
10W	202	48
20W	323	57
30	538	68
40	850	84
50	1174	100

The grease manufacturers also recognized the problem, and have made their contribution to industry by the National Lubrication Grease Institute Standards for grease consistency numbers without reference to quality.

NLGI Grease Classifications

NLGI Number	ASTM Worked Penetration Units
0	355-385
1	310-340
2	265-295
3	220-250
4	175-205
5	130-160
6	85-115

Many suppliers incorporate these consistency standards in their brand names because they have become common yardsticks and can be interpreted by workmen in industry.

Mr. Bailey began his employment with the United States Steel Corporation in 1936 upon graduation from Ohio Northern University with a B.S. degree in Mechanical Engineering. In 1938 the M.E. degree was granted by the same university.

He served as assistant to the Division Superintendent of Maintenance at Gary Sheet and Tin Mill until transfer to the company's Research Laboratory on electrolytic tinning. In 1942 he was made Plant Lubrication Engineer for the Gary Steel Works and in 1945 Special Engineer, Operating Methods.

In 1950 Mr. Bailey was transferred to his position in National Tube Division of the United States Steel Company as Lubrication Engineer in charge of the United States Steel Lubricant Testing Laboratory.

The product name commonly referred to as "brand name" has an important function in commerce and is guarded by all manufacturers. It is not intended to eliminate, discredit, or in any way detract from the merits of names because that is not the issue. The honored brand name can become a problem to its owner when it is garbled, mis-spelled or transposed. This is indicated by the fact that most suppliers have, in addition to brand names, formula numbers, brand numbers, or some form of numerical identification of the product.

The large users in quantities and varieties of petroleum products are confronted with the same problem. Many have developed their own identification systems either for specifications or description of brand names. The most simple lubricant classification system identifies each different lubricant merely by consecutive numbers, such as Lubricant No. 1, which is the identification for an oil of a certain specification suitable for a given application range. Lubricant No. 2 is the identification for an oil of a different specification and application. Greases of various analyses and applications are assigned consecutive numbers for identification in the same manner. This approach is preferred for simplicity and record keeping. It eliminates any confusion which may be caused by trade names having no meaning in connection with the application.

A more elaborate classification system is currently used by the author's company to reveal in code number form the usage of a brand name product without revealing the detail of the analysis. In the majority of cases the supplier assigns the classification number describing the brand name product offered, thereby eliminating any danger of revealing trade secrets. The brand name is always listed with the classification number using SAE, NLGI or supplier's code number, if one exists, to a limit of twenty-five letters.

The general requirements for a system to meet or solve a large consumer's problems may be listed under four objectives:

1. To be adaptable to IBM coding for correlation to other codes for recording various statistics.
2. To arrange listing in order of similar types of materials and increasing or decreasing grades of consistency.
3. To cross index four thousand products supplied by more than one hundred suppliers to sixty-five plants.
4. To indicate possible substitutions from alternate sources or in emergencies.

The key to the present classification code used by the Petroleum Purchasing Committee of the author's company is designed to meet these requirements, and is, therefore, described in greater detail.

Mineral Oils Measured at 100 F. S.S.U.

The first two-digit number indicates the class or type of material as stated in the following tabulation. The three digits following the first dash indicates viscosity at 100 F. in ten second units. The last two digits make the number individual for a particular brand-name product. The vacant or unused numbers are available for expansion to other classes not yet developed.

Straight Engine Oil 11-000-00
This class is a once-through lubricant such as used for hand oiling without any extra processing which may be indicated, but not necessarily, by a high pour point.

Mineral circulating oil with additives 12-000-00
This class is a highly refined oil suitable for circulating systems with one or more of the principal additives used for oil stability and metal protection.

Non-additive circulating oil 13-000-00
This class is a refined oil suitable for circulating systems but without additive compounding.

Internal combustion engine crank case oil 14-000-00
Including Diesel and automotive additive oils.

Process and protective coating oils 15-000-00
This class includes special compounds required for processing and corrosion protection during shipment and between manufacturing operations.

Soluble and cutting oils 16-000-00
This class includes the metal working, machining, and treating lubricants.

Special oils at 100 F. 19-000-00
This class covers all miscellaneous specialty products with unique properties but having a consistency in the range of Saybolt instrument at 100 F.

Mineral Oils Measured at 210 F. S.S.U.

The first two-digit number indicates the class or type of material as stated in the following tabulation. The three digits following the first dash indicate viscosity at 210 F. The last two digits make the number individual for the brand name product intended.

Uncompounded cylinder oil	20-000-00
Compounded cylinder oil	21-000-00
Extreme pressure fluid compounds	22-000-00
Residuum gear shields and all black oils	23-000-00
Special oils at 210 F.	29-000-00

Greases Measured by ASTM Penetration

The consistency measurement of grease is ASTM penetration and for all class numbers above 30 the three digits formally giving viscosity are a direct reading of ASTM penetration.

Calcium soap greases	30-000-00
Soda soap greases	31-000-00
Mixed base greases	33-000-00
Graphite compounding	34-000-00
Extreme pressure grease	35-000-00
Barium or lithium grease	37-000-00
Open gear grease	38-000-00
Special grease	49-000-00

Block grease	50-000-00
Asphalt and road oil	60-000-00
Products not otherwise specified	70-000-00

Special Products Classification

If the product cannot be measured within the limits of Saybolt Viscosity or ASTM penetration, the arbitrary numbers 000 to 005 are used following the first dash to indicate no consistency reference.

When the viscosity is greater than 990 SSU at 210 F. the numbers 991 to 999 indicate consistency by the third digit in thousand second units.

The preceding classification keys have illustrated each class by the first two digits with the remaining portion of the number shown as zeros. The following table illustrates by means of a hypothetical brand name for each of the five groups; namely, oils at 100 F., oils at 210 F., greases, high viscosity oils, specialty products.

Example

A B C oil, SAE 10W	14 021 42
X Y Z cylinder oil	21 175 45
E P Grease O	35 360 47
High viscosity oil	23 995 46
Special product oil	19 001 43

The Lubrication Engineers Manual which is a Lubricant Suppliers Product Index presents the entire classification key in the following condensed form showing the purchasing statistics code for each class of lubricant.

LUBRICATION MANUAL CODE

Mineral Oils Measured at 100 F. S.S.U.

The three digits following the first dash indicate viscosity in ten second units. The last two digits identifies the supplier and the brand name. The remaining portion of the numbers is purchasing statistics code.

Straight Engine Oil	11-000-00	11516
Mineral oil with additive	12-000-00	11512
Non additive circulating	13-000-00	11512
Diesel engine & motor oils	14-000-00	11517
Process or coating oils	15-000-00	11518
Soluble and cutting oils	16-000-00	11514
Special oil at 100 F.	19-000-00	11518

Mineral Oils Measured at 210 F. S.S.U.

The three digits following the first dash indicate viscosity at 210 F. The last two digits identifies the supplier and the brand name item. When the viscosity is greater than 990 S.S.U. at 210 F. the numbers 991 to 999 indicate consistency in thousand second units. The remaining portion of the number is purchasing statistics code.

Uncompounded cylinder oil	20-000-00	11513
Compounded cylinder oil	21-000-00	11513
E P fluid compounds	22-000-00	11515
Gear shields black oils	23-000-00	11511
Special oils at 210 F.	29-000-00	11518

Greases Measured by A.S.T.M. Penetration

The three digits following the first dash is the A.S.T.M. penetration. The last two digits identifies the supplier and the brand name item. The remaining portion of the number is purchasing statistics code.

Calcium Soap Grease	30-000-00	11521
Soda Soap Grease	31-000-00	11524
Mixed Base Grease	33-000-00	11521
Graphite compounding	34-000-00	11522
Extreme pressure grease	35-000-00	11522
Barium or lithium grease	37-000-00	11524
Open gear grease	38-000-00	11523
Special greases	49-000-00	11522
Block grease	50-000-00	11522
Asphalt & road oil	60-000-00	11600
Products not specified	70-000-00	11900

Special Product Classification

If the three digits following the first dash are 000 to 005 the product is not within the limits of Saybolt viscosity or A.S.T.M. penetration and the number has no reference to consistency. When the viscosity is greater than 990 S.S.U. at 210 F. the numbers 991 to 999 indicate consistency in thousand second units.

If the number of products to be classified is fewer than the numbers available within the manufacturing range of viscosity or penetration, the sixth and seventh digits would not be required. That is to say, if the manufacturing range of a given oil or grease would be 10 seconds in viscosity or 10 units of penetration the sixth and seventh digits would not be required to make the number individual to the brand name product since the fourth and fifth digits would serve this purpose satisfactorily. However, if there were fifteen products it would be necessary to use extra digits to make the number individual. The use of the extra digit numbers assigned to each supplier serves the purpose of supplier identification and they have been so used to make the present classification versatile.

The accomplishment of the four objectives for a satisfactory standardization of industrial lubricants is aided by the use of an IBM machine. The IBM procedure is used in mechanically sorting for listing all lubricants by type classes under a major control. Also, in order of consistency, it permits cross indexing by suppliers as well as by plants under a minor control. This job is greatly appreciated when large numbers of products and plants are involved.

To restate the issues of brand names or specifications, it is believed that the specification purchase of lubricants is advisable only if consumption is large and adequate laboratories and petroleum chemists are available to accept the responsibility for the quality obtained. Most industrial plants are not in a position to accept this responsibility. Some employ lubrication engineers whereas others rely on the normally excellent engineering service furnished by the supplier or employ a consulting lubrication engineer and commercial laboratories.

In conclusion, this presentation of an approach to a method of classification for industrial lubricants has been designed to meet the four objectives set forth for a desirable standardization method. It does not interfere with either specification or brand name products.

Discussion

BY DAVID W. SAWYER, *Lubricants Division, Aluminum Co. of America*

Mr. Bailey has presented a well-planned and thought-out system of classifying and coding lubricants, which is an essential initial step in the standardization and subsequent specification buying of oils and lubricants by a large consumer. Aluminum Company of America has set up a similar nomenclature system for classifying and coding lubricants that are used in our twenty-nine plants.

Approximately seven years ago our Company recognized the need for some type of standardization of oils and lubricants and at that time work was started to set up such a standardization program. Since this program

has been in effect, we have been able to cut down the lubricant inventory in our various plants from approximately 1,000 different items to 115 at present. When our program is completed, we expect to have not more than 50 to 75 standard lubricant classifications.

The nomenclature system used by Aluminum Company of America differs somewhat from that in use in the United States Steel Corporation and outlined in Mr. Bailey's paper. Our nomenclature program has been divided into two systems. One system, known as the ML (mechanical lubricants) system, includes all petroleum, synthetic, and miscellaneous products used in connection with the lubrication of mechanical equipment. The other system, known as the PL (process lubricants) system, includes all lubricants and miscellaneous materials necessary in the processing or metal working of aluminum-base and magnesium-base alloys. Three digit numbers are used in both of these systems for identifying lubricants. Our system differs from the United States Steel Corporation system in that the numbers assigned to the lubricants have in no way been coded with application, viscosity, or any other chemical or physical property of the lubricants.

Discussion

BY GEORGE F. BOWERS, *Lubricating & Industrial Sales Department, Standard Oil Co. (Indiana)*

Mr. Bailey is to be complimented on his fine presentation of an interesting subject.

In view of the fact that this paper was presented as a description of a method that is in use rather than one classification method in preference to others, my comments will be confined to possible weaknesses of this system and the unused potential value of this system.

There is no question but that every marketer whether it be of oils, steel or any other commodity is jealous of their trade name and therefore expend every effort to maintain a high quality and fine reputation for goods marketed under their trade name. This classification system recognizes that situation and thus insures fundamental harmony and cooperation with the various suppliers. Furthermore, the fact that the supplier is responsible for the specific coding of his own product insures their being properly catalogued and substantially reduces the danger of errors of misapplication.

There is one case wherein this classification presents a problem and that is where a name or number of the product is known, but the type or characteristics are unknown. This problem can be solved by an extra IBM run listing the products alphabetically, but it does result in a somewhat more cumbersome situation. Actually this difficulty is relatively inconsequential when compared with the value of the classification in other respects.

I have had the opinion for some time that the IBM system could be utilized very advantageously by a lubrication engineer and I believe that Mr. Bailey has a sound foundation on which he can build an almost foolproof system of lubrication engineering service in his plants. This can probably be demonstrated best by using a specific case. In all plants doing industrial processing there are gear cases and circulating systems. It is a recognized fact that the lubricant should be changed at regular intervals. Unless there is some system of checking there is always a question as to whether or not the lubricant was changed at the proper time if at all. The IBM cards used in this classification can be adapted very easily to cover all systems which are to be changed. This is advantageous from several standpoints. First, there is a record of all the systems easily available. Second, the work load of changing the systems can be spread into even monthly increments or to coincide with generally accepted shutdown practices. Third, a typewritten list is produced by the IBM machine which can be used as a check-off by both the man responsible for changing the lubricant and the supervisor responsible for such work. This is one illustration of an important use of the system and there are many other advantages to be realized by taking advantage of the versatility of the IBM system.

I believe Mr. Bailey's classification does meet the four objectives he established and is very usable.

Discussion

BY C. C. GOEHRING, *Esso Standard Oil Co.*

The U. S. Steel Lubricants Classification scheme constitutes an approach towards simplifying the problems confronting large manufacturers purchasing a myriad of products from many suppliers for use at different locations. From the user's point of view, a numerical treatment is desirable as it affords a ready means of brand name identification, grade differentiation and basis for statistical analysis and review.

This system, however, does not indicate significant differences between products in the various lubricant classes. For example, it does not reveal such practical information as the type of engine oil base, the detergency level of diesel engine and motor oil, the per cent and type of compounding in cylinder oil, the base oil viscosity of grease and the type of graphite in products with graphite compounding.

Unfortunately, this limitation acts to restrict wider application of the classification scheme in that it cannot be employed to designate products in a lubrication survey, or as positive indication of replacement lubricants from alternate suppliers.

In this regard, the Lubrication Manual Code could probably be made more definitive without major modification of structure by enlargement of the classes described by the first two digits. As currently established, 23 numbers segregate the various types of lubricants. Since 99 numbers are available with a two-digit structure, variety within individual classes could be differentiated to a greater extent.

To determine whether or not all possibilities could be categorized within 99 separate classifications would require considerable additional study. At first glance, it would appear that this number of classifications would be insufficient considering the number of variables with regard to additives, percentages and types of compounding, types of lubricants, etc. However, from the practical standpoint, it may be entirely feasible to develop a more comprehensive classification scheme which would be practical without an ultimate breakdown of the possible combinations.

Esso Standard has investigated several coding systems for its products in an attempt to conduct studies with regard to ingredients, manufacturing operations, distribution methods, etc. As with the U. S. Steel system these codes were adaptable to business machine use and were based on a numerical approach. Our experience has indicated that a system comprising at least 6 digits is required for adequate classification. In order to limit the number of digits to 6, it was found necessary to establish sub-codes to describe consistency or viscosity with less than 3 digits. The use of sub-codes, however, results in a reduction in simplicity. This is an important objection since, above all, simplicity is one of the most desirable features of any coding system. As a system becomes more complicated, its practicality is reduced.

APPLICATION *of infra-red spectroscopy to lubrication engineering**

BY GEORGE RAPPAPORT, *Chemist, Materials Lab, Wright Air Devel. Center, Dayton, Ohio*

Modern lubricants, as is well known, represent relatively complex chemical systems. Synthetic oils, viscosity improvers, antiwear-additives, extreme pressure-additives, pour-point depressants, and corrosion preventives serve to illustrate the wide variety of components encountered in the analysis of lubricants. Identification of these components, which in themselves often are ill-defined chemical entities, by means of conventional chemical techniques would be a difficult task indeed. Infra-red Spectroscopy is ideally suited to the solution of such problems for the following reasons:

a. all organic compounds possess an infra-red absorption spectrum which may be interpreted in terms of molecular structure.
b. The infra-red spectrum of a mixture is an additive function of all the components comprising that mixture.
c. The infra-red spectrometer allows the determination of the characteristic frequencies of vibration and rotation of molecules. These frequences in turn are functions of the arrangement of the atoms in space and the forces existing between them.

In addition, infra-red analysis is rapid and requires but small sample size, the order of magnitude of which depends, of course, on the type of problem at hand.

At this point one might ask, "Why should the Air Force concern itself with the compositional analysis of lubricants?" As long as a lubricant meets specifications and performs adequately in the particular application for which it has been designed, there is obviously no need for analysis. If a particular lubricant fails to meet specifications, again analysis appears to be superfluous. On the basis of past experience, however, it can be stated that analytical data on lubricants are essential to the solution of Air Force problems. The infrared analyses cited in this report are not only representative of the type of problems that may be solved by means of infra-red techniques, but also illustrate the need of the Air Force to concern itself with the compositional analysis of lubricants. The results are not those derived from the comprehensive investigation of lubri-

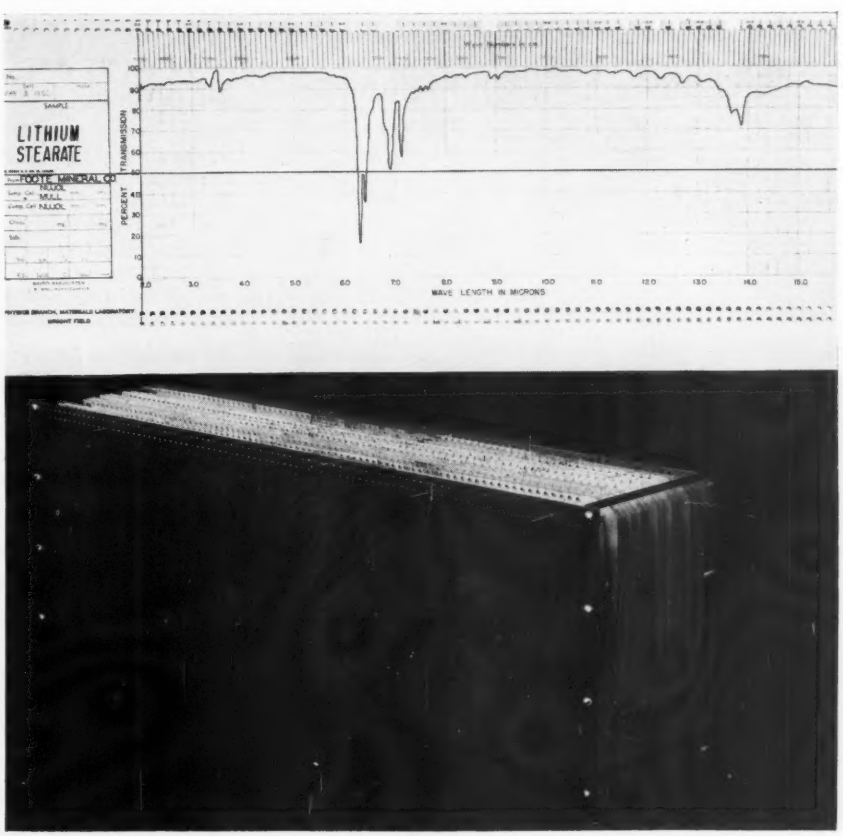


Fig. 1
TOP: *Punch card of a compound as found in the file of spectograms.*
BOTTOM: *Tray used for sorting and storing spectra.*

* Paper presented at 7th Annual Meeting, ASLE, Cleveland, April 9, 1952. The opinions expressed in this paper are those of the author and do not necessarily represent the official opinion of the USAF or the Wright Air Development Center.

cants but rather the information gained through the solution of specific problems.

Apparatus

The instrument employed was a Baird Associates Double-Beam Spectrophotometer. This instrument and the sample manipulation techniques utilized are those routinely employed in infra-red analysis and therefore require no detailed description. However, for the sake of those who have not had the opportunity to become acquainted with infra-red instrumentation in general, a brief outline of the essentials of infra-red spectrometers is given here. Infra-red spectrometers consist of three major components:

a. Source of radiation.
b. Monochromator.
c. Detector-amplifier system.

The most commonly used sources of continuous infra-red radiation are the globar and the Nernst lamp. The monochromator section, the function of which is to separate the continuous infra-red radiation into narrow wavelength intervals, may be of the prism or grating type. The radiant energy that is made to impinge on the detector, is converted into electrical energy. The electrical signal is then greatly amplified and used to drive a recorder or servo system. The detector may be of the bolometer or thermocouple type. The Baird instrument contains a rocksalt prism monochromator and a bolometer. The amplified signal from the bolometer drives a servo-mechanism that allows direct percent transmittance recording.

The method used for sorting infra-red spectra is in some respects unique to the author's laboratory and will bear description. Baird spectra are recorded with black ink and are transferred directly to a McBee punch card file through the Ozalid process. All that is necessary to incorporate a spectrum in the punch card file, is to take

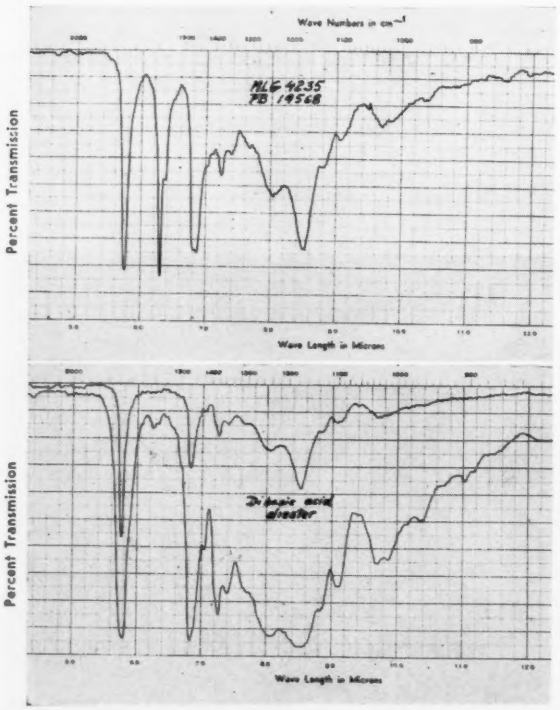


Fig. 2
TOP: *Spectrum of a grease containing a dibasic acid diester oil.*
BOTTOM: *Spectra of two thicknesses of a dibasic acid diester oil.*

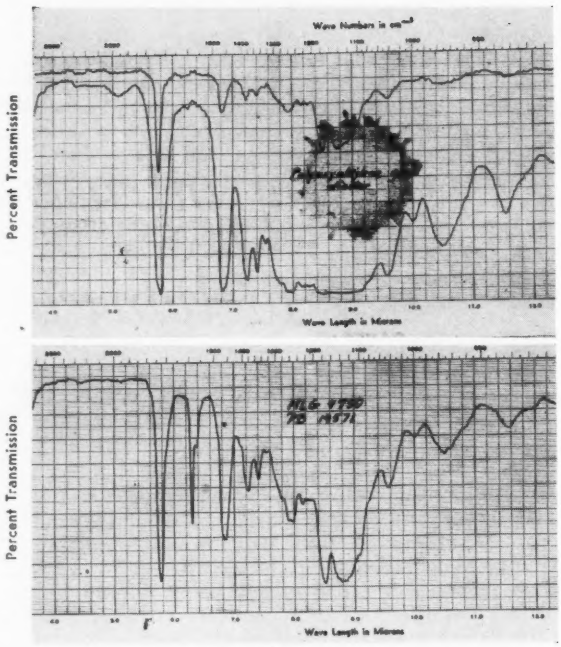


Fig. 3
TOP: *Spectra of two thicknesses of polyoxyalkylene glycol diester oil.*
BOTTOM: *Spectrum of a grease containing polyoxyalkylene glycol oil.*

the spectrum as recorded on the Baird Spectrophotometer, superimpose it on a McBee Ozalid punch card, send it through an Ozalid machine and punch the card in appropriate places. For a file containing not more than a thousand spectra the Ozalid punch card system is adequate. Due to the relatively large size of the Ozalid punch card the sorting of much more than a thousand cards would become cumbersome. More comprehensive infra-red sorting systems are coming into general use.[1, 2] For individual sorting systems of limited size, the Ozalid punch card has the advantage that the spectrum is placed on the punch card and to accomplish this requires but little time and effort. Figure 1 shows one of the trays used for sorting and storing the punch cards and also a typical punch card.

Examples of Analyses

Air Force procurement people were in the process of buying bearings and specifications required that these bearings be furnished packed with AN-G-25 type grease, rather than a petroleum base oil grease. Bearings were sent to the laboratory to determine what type of grease was used. Obviously, not enough grease could be removed from these bearings to perform specification testing. To differentiate greases containing hydrocarbon oil from those containing ester type oil is a simple matter requiring no instrumentation. The infra-red spectrum, determined in a matter of minutes will not only tell the analyst that the grease contains an ester type oil rather than a hydrocarbon type oil, but also prove that this ester is one of those expected to be present in AN-G-25 specification grease. A survey of all AN-G-25 type greases that were qualified under this specification revealed that two different synthetic oils were used in their formulations. Some of these greases were found to contain a dibasic acid diester oil while others contained polyoxy-

[1]Codes and Instructions for Wyandotte Punched Cards Indexing Infra-red Absorption Spectrograms. Lester E. Kuentzel. Wyandotte Chemicals Corp. 1951.
[2]National Research Council Committee on Infra-red Absorption Spectra.

alkylene glycol diester. The infra-red spectra of the dibasic acid diester oil, together with that of a grease containing this type oil are shown in Figure 2. The infra-red spectra of a polyoxyalkylene glycol diester type oil and of the grease from which it was extracted are shown in Figure 3. The presence of a band at 8.75 microns in the spectrum of the polyoxyalkylene glycol diester that is due to the ether linkage, readily differentiates this oil from a simple diester. Determination of the type of oil used in the grease can be made without separation of the oil, directly by means of the spectrum of the grease.

Some time ago it was found to be necessary to amend a specification covering a hydraulic fluid to assure incorporation of an anti-wear additive. Some of the interim deliveries of this fluid had to be checked to assure that they met the amended specification. This anti-wear additive, tricresyl phosphate, was present in the hydraulic fluid at such a low concentration that its presence could not be determined by means of the infra-red spectrum of the hydraulic fluid. The methanol extract of the hydraulic fluid did, however, contain a sufficiently high concentration of the tricresyl phosphate to allow determination of its presence by means of infra-red analysis. Methanol extracts materials other than tricresyl phosphate from the hydraulic fluid but the presence of a band at 10.35 microns in the spectrum of the extract is sufficiently conclusive evidence for the presence of the phosphate group. The infra-red spectra of the hydraulic fluid, tricresyl phosphate, and the methanol extract of the same hydraulic fluid are shown in Figure 4.

There are a number of lubricating oil additives on the market for which some extravagant claims have been made. Obviously it would be a waste of time and effort for the lubrication engineers to run full scale engine tests on the performance of each of these wonder additives, particularly if they contain components that are known to be harmful to the engine. Infra-red analysis has played an important part in eliminating some of these "snake oils" by virtue of identification of components which the Air Force will not tolerate in lubricants. One such component was identified as parachloronitrobenzene this compound was separated, from the liquid in which it was furnished, by means of solvent extraction. It was then purified by recrystalization and its infra-red spectrum was obtained. This infrared spectrum was found to possess absorption bands characteristic of the aromatic nitro group. This information, together with the melting point and the presence of a halogen indicated the unknown materials to be parachloronitrobenzene. Final proof was furnished by the spectral matching of the unknown and a synthetic sample of parachloronitrobenzene.

Engineers charged with the evaluation of lubricants submitted for Air Force use often lack compositional data on these products. Such data may often be obtained faster through analysis than through correspondence. The occasion arose, for instance, for the determination of the presence of lead naphthenate in a lubricant. Isolation of naphthenic acids and their spectral comparison with known samples of naphthenic acids can be performed in short order. Figure 5 shows the spectral comparison of a known and unknown sample of naphthenic acids. This type of analysis is typical of the ability of infra-red spectroscopy to furnish useful information on such chemically ill-defined mixtures as naphthenic acids.

Infra-red data on components of lubricants have aided in the solution of problems encountered by the Air Force that were unrelated to lubricants as such. A viscous liquid that was removed from the deicing system of an aircraft was identified by means of its infra-red spectrum as a polymeric viscosity index improver. Evidently this material had gotten into the deicing fluid through an error in the servicing of the aircraft.

Fretting corrosion is a problem that is under intensive investigation of lubrication engineers. Fretting corrosion has been experienced in helicopter rotor bearings and

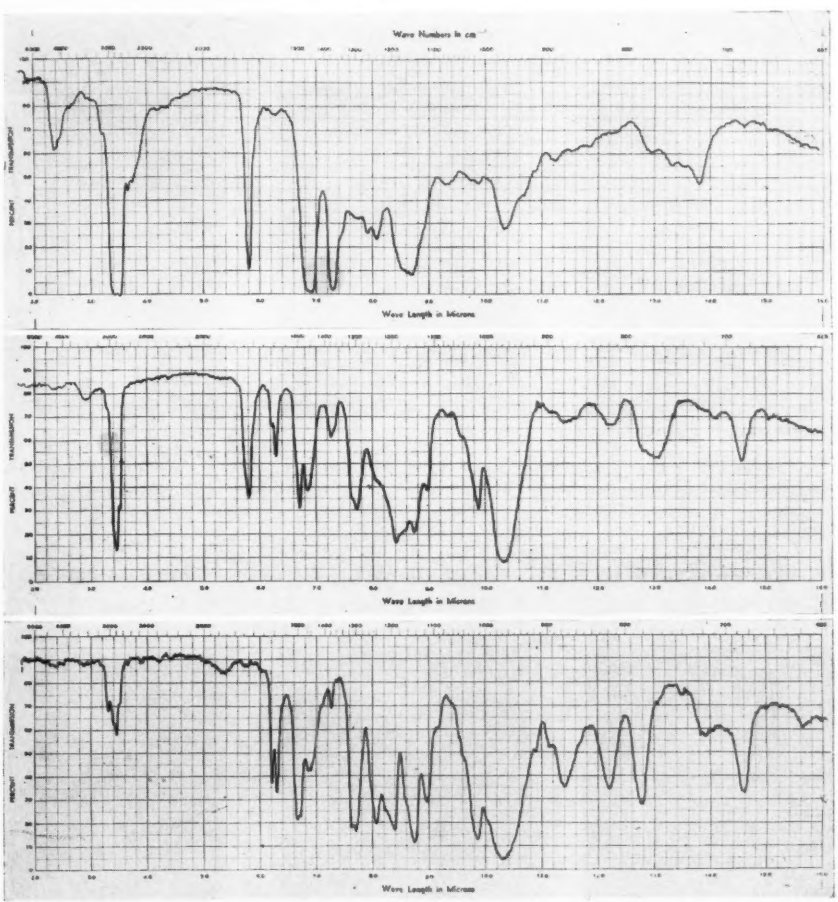


Fig. 4
TOP: *Spectrum of a hydraulic fluid.*
MIDDLE: *Spectrum of the methanol extract of the same hydraulic fluid.*
BOTTOM: *Spectrum of tricresyl phosphate.*

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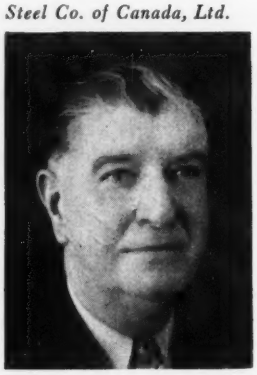

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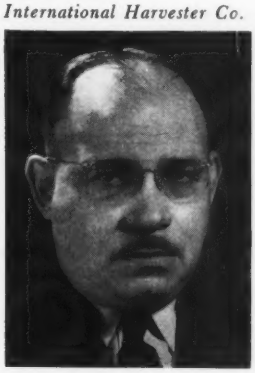

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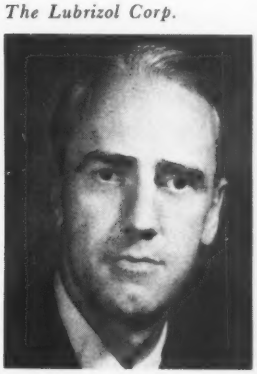


MR. RAPPAPORT was born in Hungary and received his elementary education in Europe. He completed his undergraduate work in this country and received his B.S. degree in Chemistry from the University of Miami in 1944. From 1944 to 1946 he was with the U. S. Armed Forces. In 1946 he joined the Physics Branch of the Materials Laboratory at Wright-Patterson Air Force Base, where he has been engaged in infrared spectroscopic analysis since that date. He obtained his Masters degree thru Ohio State University Graduate Extension at Wright-Patterson Air Force Base in 1950.

service personnel indicated that greases from different manufacturers performed differently even though these greases were procured under the same specifications. The infrared spectra of these greases were found to be quite similar yet sufficient spectral differences were noted to establish the probable manufacturer of a particular grease. This type of information must be handled with due reservations, since batch to batch variations in the product of a particular manufacturer may result in observable differences in their infrared spectra. In fact, the only information that the infrared analysis can provide in such a case without reservations, is the identity of or differences in the major components of two grease samples. Yet the practical implications of such results cannot be ignored.

The most attractive feature of infrared analysis in its industrial applications is that in the course of the solution of each problem, spectral data are obtained which may be of considerable importance in the solution of future problems. It is, of course, important that all data collected be in a form suitable for immediate use. Filing of spectral data by means of punch cards so that they may be sorted according to common spectral features or chemical composition is one of the means that allows utilization of the results of past experience. The importance of the experience of the analyst in infrared spectroscopy should also not be underrated, as the pitfalls in the interpretation of infrared spectra are many. Poor instrumentation, faulty sampling techniques, insufficient knowledge of the chemistry of the systems studied may all lead to inconclusive or erroneous results in the interpretation of infrared spectra.

Provided then, that spectral data are filed efficiently and proper care is exercised in recording and interpreting such data, infrared spectroscopy can and has become a very powerful analytical tool for the investigation of lubricants. In addition to the analyses described in detail, the author has developed infrared methods for the quantitative analysis of silicone-diester oils, for the determination of polymeric viscosity index improver content of petroleum oils, and contributed to the research and development program on fluorocarbon additives by investigating the molecular structure of newly synthesized compounds. Although the infrared analysis of lubricants is a relatively new field, its fruitfulness and future productivity appear to be well assured.

The author wishes to acknowledge the help extended to him by Mr. J. C. Mosteller and Mr. B. Rubin in suggesting the analytical problems to be investigated by means of infrared spectroscopy and explaining the significance of the results in terms of lubrication engineering.

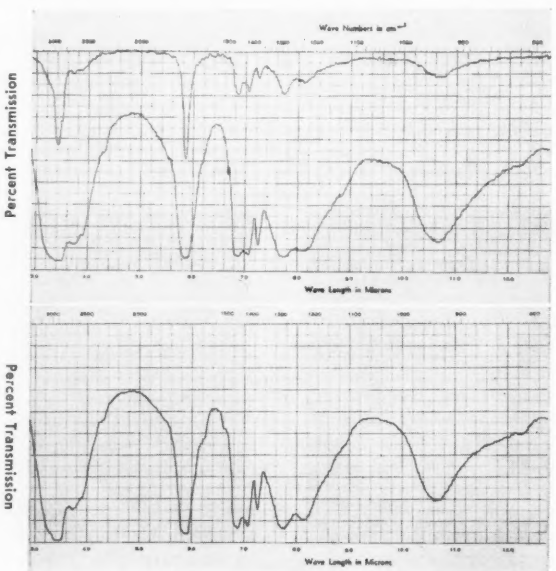


Fig. 5

TOP: *Spectra of two thicknesses of naphthenic acids separated from a lubricant.*

BOTTOM: *Spectrum of mixed naphthenic acids.*

practical lubrication --A NEW SERIES

"Grease Lubrication of Ball Bearings," on page 120 of this issue, is the first in a new series of technical articles to appear in LUBRICATION ENGINEERING. The August issue will feature "What Lubrication of Coal Mining Machinery Means to Management," by C. W. Thompson, National Mines Corporation. Mr. Thompson first presented this paper at the ASLE Seventh Annual Meeting.

At the conclusion of this series, the Society will publish the papers in book form as another of its practical lubrication manuals.

INFLUENCE

of point of application of cutting oil on tool life

BY WILLIAM E. LAUTERBACH, *Materials Eng. Section, Armour Research Foundation*

Purpose of Experimentation

The purpose of the experiments described in this paper was to determine the influence of the point of application of a cutting oil on the life of a single-point tool employed in a lathe turning operation.

Test Procedure

A limited series of tool-life tests were conducted on a tool-room lathe in accordance with the test method and general specifications of the American Standards Association.[1] These tests consisted of removing a chip from a test log with a single-point tool in a continuous turning operation under specified cutting conditions, until the breakdown (abrupt failure) of the tool point occurred. The tool life is defined as the cutting time required to produce this ultimate failure of the tool.

Six high-speed steel, single-point tools were ground to the shape shown in Fig. 1a. In two of these tools, two grooves were added in the side clearance face as illustrated in Fig. 1b, so that the "tips" of the grooves were located within the first 0.100-inch back from the nose of the tool (end cutting edge).[2] Hence, the "tips" were directly under that portion of the cutting edge over which the chip would pass if the tool were cutting at a depth of 0.100 inch. For convenience, the two types of tools represented in Fig. 1a and Fig. 1b are designated as "standard" tools and "grooved" tools, respectively.

Two individual tool-life tests were conducted under each of the following test conditions:

1. Cutting oil directed *up* into the clearance crevice between the side clearance face of a *standard* tool and the workpiece shoulder left by the chip removal, as illustrated in Fig. 2.
2. Cutting oil directed *down* on *standard* tool and chip.
3. Cutting oil directed *up* into the clearance crevice between the clearance face of a *grooved* tool and the workpiece shoulder left by the chip removal.

All tests were made under the cutting conditions listed in Table I; the only variables were the two previously noted, namely, tool type and point of application of cutting oil. The feed, depth of cut, and cutting speed were chosen on the basis of previous tool-life tests, such that the ultimate tool failures could be expected within a reasonable cutting time. From a study of published material relative to tool life it was surmised that the results of tool-life tests conducted under these more or less exaggerated cutting conditions would give a valid indication of the tool behavior under cutting conditions comparable to those employed in an actual industrial operation.

Results and Conclusions

The results of this series of tool-life tests are shown graphically in Fig. 3. The two tool-life tests conducted with the cutting oil directed *down* on the *standard* tool (as is common practice in many industrial turning operations) gave an average tool life of 8.37 minutes. The two tests conducted with the cutting oil directed *up* into the clearance crevice between the *standard* tool and the workpiece shoulder gave an average tool life of 17.35 minutes, which represents an increase in tool life of 107 per cent. The two tests conducted with the cutting oil directed *up* into the clearance crevice between the *grooved* tool and the workpiece shoulder gave an average tool life of 18.98 minutes, representing an addi-

TABLE I

CUTTING CONDITIONS OF TOOL-LIFE TESTS

Machine Tool:	Tool-room lathe. Size: 14-in. swing, 6-ft. bed.
Test Log:	SAE 3140 hot-rolled annealed as received. Original size: 8 in. diameter by 20 in. long. Log No.: 4.
Cutting Tool:	High speed steel as received. Original size: ⅜ in. sq. by 3 in. long. Hardness: Rockwell C58 ± 3. Tool shape: 8, 22, 6, 6, 6.5, 15, 3/64. (See Fig. 1a.) Tool type: As specified in Table II.
Tool Support:	Tool-force dynamometer. Setting angle of tool: 90°. Back slope of tool: 0°.
Feed:	0.0118 in. per rev.
Depth of Cut:	0.100 ± 0.005 in.
Cutting Speed:	160 f.p.m.
Cutting Fluid:	Lata 21B 3285. Volume: 2.0 gal. per min. Temperature: 109 ± 2 F. Point of application: As specified in Table II.
Room Temperature:	70-80 F.

*The results presented were obtained during an investigation sponsored by the Shell Oil Company at Armour Research Foundation, Chicago, Illinois.

MR. LAUTERBACH received his B.S. degree in Mechanical Engineering from Antioch College in 1945 and since has taken graduate work in the field of Mechanics at Illinois Institute of Technology.

Upon graduation he joined the staff of Armour Research Foundation, where he has been the Project Engineer on two long-range research programs. In 1951, he became Assistant Supervisor of the Materials Engineering Section.

tional increase in tool life of 9.5 per cent, or a total increase of 127 per cent. It can be seen in Fig. 3 that good reproducibility of results was experienced in these tests.

It is generally agreed that the two primary functions of a cutting oil in a machining operation are (1) to provide lubrication of some sort between tool and chip and between tool and workpiece, and (2) to provide cooling of the cutting tool. In regard to lubrication, previous theoretical and experimental investigations [3, 4] on this same metal cutting program have supported a contention that, although a cutting oil (entering from the clearance crevice) may provide hydro-dynamic or "thick film" lubrication between tool and chip at extremely low cutting speeds, it does not provide hydrodynamic lubrication at higher cutting speeds; however, other experimental research [5] strongly indicates that the oil may serve as a carrier for the introduction of additives between the tool and chip at higher speeds, thus providing solid lubrication during the cutting process. The successful achievement of either of the two "duties" of a cutting oil would be expected to increase the ultimate tool life in any given machining operation. Hence, the results of these tool-life tests indicate that, in a turning operation, cutting oil performs its functions more effectively when the oil is directed up into the clearance crevice than when it is directed down over the tool and chip. Apparently, the oil has freer access to the actual cutting edge of the tool when introduced into the clearance crevice instead of being flooded over the tool from the top where the chip is being removed from the workpiece; thus, the oil can do a better job of cooling the tool and/or providing some lubrication between the tool and workpiece and between the tool and chip.

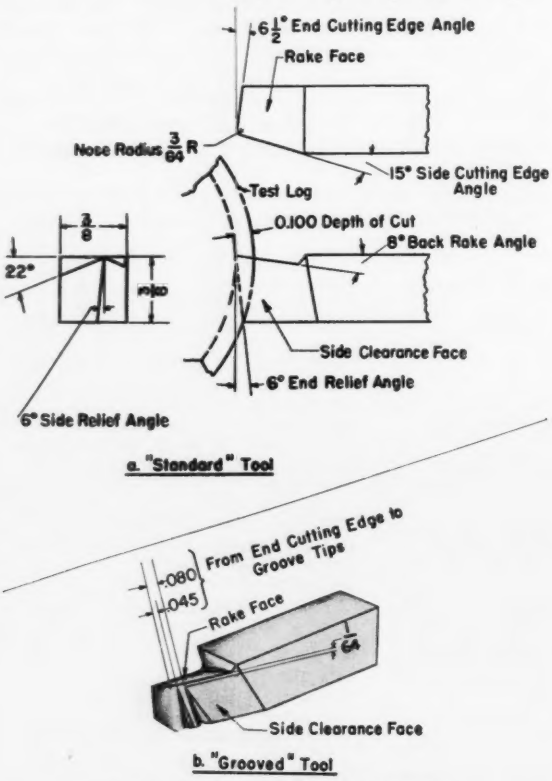


Fig. 1. Cutting tools for tool-life tests.

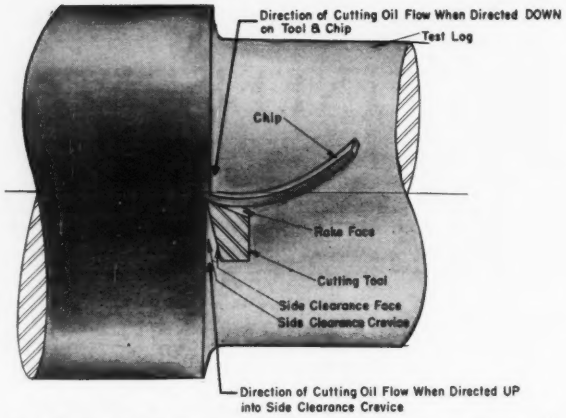

Direction of Cutting Oil Flow When Directed DOWN on Tool & Chip
Test Log
Chip
Rake Face
Cutting Tool
Side Clearance Face
Side Clearance Crevice
Direction of Cutting Oil Flow When Directed UP into Side Clearance Crevice

Fig. 2. Sketch illustrating points of application of cutting oil.

Acknowledgment

Grateful acknowledgment is made to Mr. H. P. Flint and Mr. W. S. Power, formerly of Armour Research Foundation, who assisted in conducting these tool-life tests.

[1]"Life Tests of Single-Point Tools Made of Materials Other Than Sintered Carbides," ASA B5.19-1946 (New York: American Society of Mechanical Engineers, April, 1946).

[2]The clearance face grooves were suggested by Dr. S. K. Talley of the Shell Development Company, Emeryville, California.

[3]Bisshopp, K. E., Lype, E. F. and Raynor, S. "The Role of Cutting Fluid as a Lubricant," *Lubrication Engineering*, Vol. 6, No. 2 (April, 1950), pp. 70-74.

[4]Lauterbach, W. E., and Ratzel, E. A. "An Investigation of the Flow and Effect of a Cutting Oil in Machining Operations," *Lubrication Engineering*, Vol. 7, No. 1 (Feb., 1951), pp. 15-19.

[5]Shaw, Milton C. "Mechanical Activation—A Newly Developed Chemical Process," J. Appl. Mech., Vol. 15, pp. 37-44.

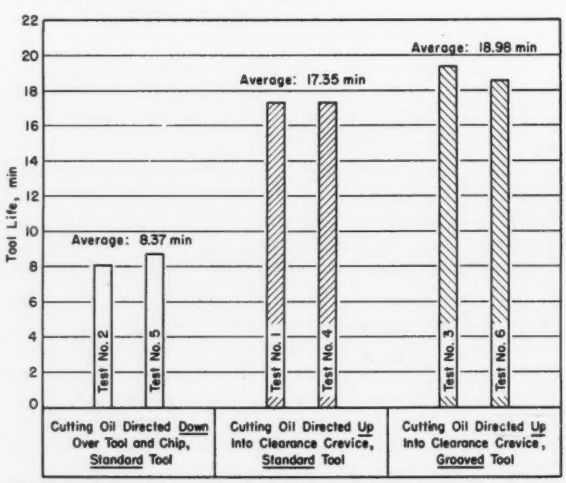
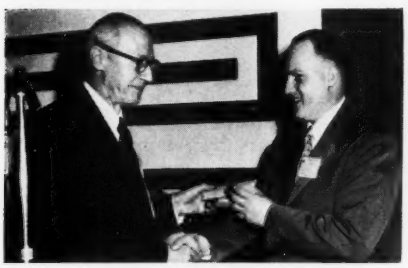


Fig. 3. Influence of point of application of cutting oil on tool life.

HI-LITES OF THE SEVENTH ASLE ANNUAL MEETING AT CLEVELAND APRIL 7-9 1952

Incoming President M. E. Merchant is presented with the gavel by Retiring President C. E. Schmitz at the ASLE Annual Banquet.

The Alfred E. Hunt Memorial Medal, sponsored by the Aluminum Company of America, is awarded to Paul J. Galbreath for the best paper on the subject of lubrication in 1951.



The Walter D. Hodson Junior Award, awarded annually for the best paper on lubrication or an allied subject by a member 30 years of age or less, is presented to Cort L. Miller.

Dean John R. Dunning, Dean of the Engineering School of Columbia University as guest speaker for the ASLE Annual Banquet, presents an address entitled "Engineering Comes of Age."

The ASLE National Award signifying life membership in the Society for an individual making outstanding contributions to the furtherance of the science and practice of lubrication, is awarded to John W. Stack.

Retiring President C. E. Schmitz is presented a testimonial plaque of appreciation by the Chairman of the Presidential Council, D. F. Hollingsworth.

Photography by Miller-Ertler Studios, Cleveland

SEVENTH ASLE ANNUAL BANQUET, APRIL 8, 1952, HOTEL STATLER, CLEVELAND

To determine the relative performance characteristics of five competing open gear lubricants, a major steel producer established the 4-Gram Test . . . an experiment which reproduces as closely as possible service conditions encountered in open gear lubrication.

In this experiment the Timken Testing Procedure was modified slightly to reproduce more precisely actual service conditions. Flow of lubricant to the hardened and ground steel block and cup was cut off, and 4 grams of the lubricant being tested were applied at room temperature. The machine then was set in motion and watched closely for signs of scoring.

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LUBRICANT "D"—6 minutes—a lead-compounded lubricant scored and failed in 6 minutes.

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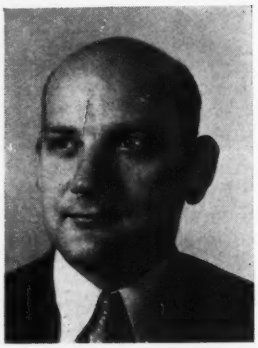
New Editor of Lubrication Engineering



Dr. Talley

S. K. Talley has been appointed Editor of LUBRICATION ENGINEERING and Chairman of the Editorial Committee. He has served as a member of that committee for the past year and, with his excellent background in the field of lubrication, is well qualified for this important assignment.

Dr. Talley graduated from Harvard in 1929 and received his Ph.D. in physical chemistry from the same institution in 1933. Except for a brief period during 1941-42, when he was employed as a process engineer by U. S. Rubber Co., he has been engaged in research and development in fuels and lubricants for Shell Oil Co. and Shell Development Co. since 1933. He is a member of ASLE, ACS, ASME, ASM, Alpha Chi Sigma and Sigma Xi, and is a registered Mechanical Engineer in the state of California.

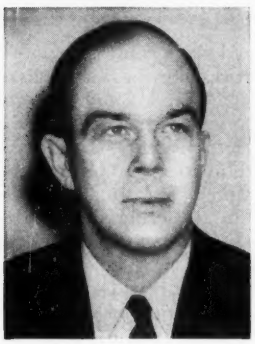
ASLE Participation in ASME Semi-Annual Meeting

Twenty-one divisions and committees of the American Society of Mechanical Engineers and five engineering societies will participate in the 1952 Semi-Annual Meeting of the ASME in Cincinnati, Ohio, June 16-19. A total of 86 papers dealing with almost every field of mechanical engineering will be presented at 38 technical sessions. Headquarters for the meeting will be the Sheraton-Gibson Hotel.

The groups co-sponsoring sessions with the ASME are American Society of Lubrication Engineers, American Society for Testing Materials, Society for the Advancement of Management, American Institute of Industrial Engineers and Engineering Society of Cincinnati.

The session co-sponsored by ASLE is scheduled for Thursday afternoon, June 19. At this session C. L. Pope, past-president of ASLE, will speak on "Plant Lubrication Engineering," and W. D. Whalen, chairman of the Cincinnati Section of ASLE, will deliver a paper on "Modern Machine Tool Lubrication Practices." Among other papers of interest to lubrication engineers, to be delivered during the four-day program, are "Machine Tool Lubrication" by J. R. Keen, "On the Solution of the Reynolds Equation for Slider Bearing Lubrication" by A. Charnes and E. Saibel, "Continuous Viscosimetry" by R. W. Fritzsche, "The Effects of Solid Inclusions in the Oil Supply to Sleeve Bearings" by H. G. Rylander, Jr., and "Definitions, Functions, Types and Designations of Cutting Fluids" by O. W. Boston.

New Appointments Made To ASLE National Staff



Youngclaus

Kluge

William P. Youngclaus, Jr., has been appointed Administrative Secretary of ASLE and Advertising and Business Manager of LUBRICATION ENGINEERING. He has been active in the field of lubrication since 1937. He majored in Mechanical Engineering at Northwestern University, graduating from there in 1935. Since that time he has "rough-necked" in the oil fields of Oklahoma and been a foreman in a gypsum plant in Texas and a sales engineer for The Pennzoil Co. During the World War II he was in charge of lubrication at the largest plant in the world, the Dodge-Chicago Aircraft Engine Plant, and later was Regional Manager of the Industrial Division of the Alemite Div. of Stewart-Warner Corp., Chicago. Mr. Youngclaus has been an active member of the Chicago Section of ASLE since 1947.

Charles R. Kluge, who has been working in the ASLE National Office for the past few months as corresponding secretary, has been appointed Editorial Assistant of LUBRICATION ENGINEERING. His past experience includes working the Production Planning Dept. of the Carnegie-Illinois Steel Corp., the Personnel and Detail Offices of the U. S. Maritime Service, the Personal Injury Claim Dept. of the EJ&E Railroad, the Employment, Industrial Relations and Cold Strip Depts. of the Inland Steel Co., and with Marshall Field & Co. A resident and native of Gary, Indiana, Kluge majored in English, Business Administration, and Psychology at Indiana University.

Lubrication Engineering Course at Georgia Tech

As previously announced, the Georgia Institute of Technology in Atlanta, Georgia, is conducting a two-week lubrication course from June 16 to 27, 1952. The ASLE is co-sponsoring this instruction. Although the hydrodynamic as well as hydrostatic theories are to be introduced and discussed, emphasis is to be placed on industrial lubrication.

Practical topics such as Bearing Design, Bearing Materials, Lubricants, Lubricant Dispensing, Recent Lubrication Developments, Lubricant Technology, Rolling Bearings, Gear Lubrication, Textile Machinery Lubrication, Cutting Fluid Technology and Lubrication Section Organization will be presented on successive days by such authorities as Mr. John Boyd of Westinghouse, Mr. Oscar Frohman of Ampco Metals, Dr. E. M. Kipp of the Aluminum Company, Mr. Andrew Cichelli of Bethlehem Steel, Dr. D. D. Fuller of Columbia University, Mr. Dean Cleaveland of Bendix Aviation, Mr. C. M. Weckstein of Timken Roller Bearing, Mr. J. L. Brusca of SKF, Mr. S. D. Craine of W. A. Jones Foundry and Machine Company, Mr. Clark Hubbard of Deering Milliken Company, Dr. M. E. Merchant of Cincinnati Milling Machine and Mr. T. R. Witt of Tennessee Eastman Company.

Each of these lecturers has contributed notably to lubrication engineering. Dr. Merchant is our (ASLE) present national president while Dr. Kipp was our second president. Dr. Fuller is chairman of our busy Educational Committee, and Mr. Cleaveland is chairman of the active Technical Committee on Lubricant Reclamation and Disposal. Dr. Joseph P. Vidosic of the School of Mechanical Engineering, Georgia Institute of Technology, is the course director.

The tuition for this two-week course has been set at $100, which includes all course supplies and materials. The Biltmore Hotel, Cox-Carlton Hotel, and the Georgian Terrace Hotel are a few blocks from the Georgia Tech campus and are recommended to those desiring hotel accommodations. Enrollment must be limited to about sixty men. To apply for admission and hotel reservations write, submitting your educational and professional record, to:

Mr. C. H. Taylor, Coordinator, Short Courses and Conferences, Georgia Institute of Technology, Atlanta, Georgia.

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NEWS OF THE SECTIONS

BALTIMORE

By H. A. Rau, Jr., Sec'y-Treasurer

March 1952 meeting—Mr. W. D. Thomas, American Cyanamid Co., addressed the membership on "Chemical Addition Agents for Lubricants," in which he traced the historical development of lubricants over the past 25 years, and showed how the use of chemical additives has solved many of the problems imposed by engine design, fuels and operating conditions. Excerpts include: ". . . In the development of the new high output engine, many problems were encountered which required in stepwise fashion the development of superior type lubricants to overcome them. The petroleum industry, working in co-operation with the equipment manufacturers, has been able to develop lubricants to meet the higher demands and has accomplished this end chiefly by the use of chemical addition agents. . . ."

CHICAGO

By F. J. Scott, Sec'y-Treasurer

March 1952 meeting — Mr. Oscar Frohman, Ampco Metal, Inc., presented an address entitled "Modern Bearing Bronzes and their Lubrication."

* * *

April 1952 meeting—Mr. Harry Krummel, Socony-Vacuum Oil Co., discussed the opportunities for savings and control by the use of the service engineering available in the lubricant and lubrication equipment fields. Excerpts of his discussion include ". . . As plants grow and expand, management loses touch with many of the details of operation, and there comes a time when procedures are often very loosely handled, because they just grew up, too, with the plant, without planning, without supervision, and without delegating responsibility for them to any one person. Due to lack of manpower, or time, or lack of ability to straighten things out, nothing is done, and the poor practices continue to exist. Very frequently the extent to which they adversely affect both direct and indirect costs is not realized, because the condition has never been analyzed. Lubrication, in its broad sense, is only too often found to be in this haphazard stage in many small to medium sized shops, and poor lubrication practices exist in storing, handling, applying and purchasing of lubricants. This lack of organization and responsibility and planning results in losses in production, in unwarranted high maintenance costs, and in wasteful labor usage. These loose practices, and lack of organization can be readily cleared up if management will only avail itself of the sound programs for good lubrication—in all its phases—that the competent engineering staffs of the suppliers of petroleum products, lubricating equipment and other accessories are glad to furnish as a customer service. Management too often misses this opportunity . . ." Cocktails and dinner were enjoyed prior to both meetings.

CONNECTICUT

By J. S. Martin, Sec'y-Treasurer

March 1952 meeting—Mr. Edward J. Gesdorf, Farval Corp., spoke on the subject "Centralized Systems of Lubrication," dealing with the practical application and servicing of centralized systems of lubrication on various types of machinery. The evening began with a dinner in the Colonial House.

KANSAS CITY

By R. R. Matthews, Chairman

February 1952 meeting—Mr. Oscar Maag, Timken Roller Bearing Co., presented a discussion on lubricating requirements for various locations, illustrated by slides which indicated the provision made for application of lubricants including centralized lubrication. Among the more important points discussed was the fact that while the manufacturer of such bearings would prefer to use lubricating oil, lubricating grease is often more practical due to the fact that less costly seals are required with the latter material. In lubricating roller bearings on railroad equipment, lubricating oil was found satisfactory where the rolling stock is kept moving, as in the case of passenger cars. However, with freight cars, which spend considerable of their life idle, rusting occurred when oil was used because with practically all the oil drained from the top rollers, they were exposed to any moisture present. Sodium base lubricating grease was

recommended as the most dependable for automotive wheel bearing lubrication.

* * *

March 1952 meeting—"Oil Qualities plus Additives Gives Performance," by Russell W. Meals, Sinclair Refining Co.

(SEE *Lubrication Summarized*)

Following the talk Mr. James Ritz of Sinclair assisted Mr. Meals in a demonstration of the effect of oil oxidation and corrosion on bearing metal when a regular type motor oil is used at high temperature, and the effect of detergency and disperancy additives in a motor oil. The physical property of viscosity was graphically shown by the use of an oil pressure-viscosity-flow apparatus set up as a crankshaft connecting rod assembly. Both meetings commenced with a dinner.

LOS ANGELES

By R. C. Dishington, Sec'y-Treasurer

March 1952 meeting—Mr. C. C. Currie, Dow Corning Corp., addressed the membership on the subject "Progress in the Field of Silicone Lubricants." The following conclusions were drawn concerning the usefulness of the Silicone lubricants now available: (1) Silicone lubricants show exceptional resistance to heat and to many corrosive materials; (2) They show relatively little change in physical characteristics over a wide temperature span; (3) Load carrying capacity may be limited or excellent depending upon the bearing-metal combination; (4) Silicone lubricants have a long service life in anti-friction bearings operating at relatively high speeds under normally encountered loads at temperatures from = 100 to + 375 F. If the bearings are lubricated, the operating temperature may be increased to as much as 700 F.; (5) Silicone lubricants are most useful where organic oils and greases stiffen at low temperature; break down in corrosive atmosphere; bleed, evaporate or form gums at high temperature.

NEW YORK

By H. Muller, Chairman

February 1952 meeting—First joint meeting with the American Society for Testing Materials and the Machine Design Div. of the American Society of Mechanical Engineers. Mr. F. L. LaQue, International Nickel Co., Inc., presented an interesting address entitled "Factors in Corrosion with Respect to Design and Lubrication Problems,"

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- No Lubricant was ever contrived or compounded without the intent to apply.
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- The permanence of a lubricant film depends upon the frequency with which replenishing lubricant is applied.
- Lubrication cannot be consummated without the application of a lubricant.
- Lubrication, therefore, is a product of two factors, Lubricant and Lubricant Application.
- A lubricant film can be maintained only if Lubricant Application is controlled.
- The control of Lubricant Application is tantamount to the control of bearing wear.
- Successful bearing performance is more responsive to frequency of Lubricant Application than to Type of Lubricant.
- The Method of Lubricant Application predetermines the lubricant consistency.
- Bearings, whether crucial or inconsequential, major or minor, operate successfully depending upon the balance between lubricant consumption and lubricant application.
- The selection of a lubricant for any purpose whatsoever, cannot be made intelligently without knowledge of the Method of Application.
- The peak of Industrial Production can be attained only to the extent that Industrial Lubrication is understood and achieved.

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covering the broad field of corrosive effects as a result of galvanic action where different materials are in contact, and fretting corrosion and corrosion effects in the range of extreme pressure lubrication.

PHILADELPHIA

By J. H. Richards, Jr., Program Chairman

March 1952 meeting—Mr. H. O. Kron, Philadelphia Gear Works, addressed the membership on the subject of "Design and Operation of Gears." During the business meeting Mr. J. L. Parsons was appointed chairman of a committee to arrange for a spring golf outing. The dinner and meeting were held at the Hotel Essex.

PITTSBURGH

By M. C. Miller, Sec'y-Treasurer

February 1952 meeting—A panel discussion on lubrication was held with Dr. C. H. von Fuchs, Consulting Chemical Engineer, Niagara Falls, Mr. S. C. Griffith, Jones & Laughlin Steel Corp., Dr. O. L. Brandes, Gulf Research & Development Laboratory, and Mr. M. L. Langworthy, The Texas Co., as panel members, and Mr. G. L. Summer, Jr., as moderator.

* * *

March 1952 meeting—Mr. J. J. Slomer, Goodman Mfg. Co., presented a discussion on "Lubrication of Mining Equipment." Both meetings were preceded by a dinner at the Sheraton Hotel.

ST. LOUIS

By M. J. Croghan, Secretary

March 1952 meeting — "Drawing Compound Types—A Discussion of Function, Makeup, and Selection," by L. R. Tharp, E. F. Houghton & Co.

(SEE *Lubrication Summarized*)

YOUNGSTOWN

By J. P. Halwachs, Secretary

March 1952 meeting — "Maintenance of oil-film Roll Neck Bearings," by S. Carson, Morgan Construction Co.

(SEE *Lubrication Summarized*)

MILWAUKEE

By E. A. Schneider, Secretary

April 1952 meeting—Mr. R. O. Sharpe, Socony-Vacuum New York Technical Staff, presented a discussion on the important phase of today's productive effort entitled "Give Life to Hydraulic Systems." The dinner and meeting were held in the ESM Building.

June Cover

SYRACUSE

Syracuse—founded on the salt industry. The development of the salt industry in the earlier years, in which brine from the wells was dried by the sun to produce the first salt other than from sea water used commercially in the United States, gave impetus to the growth of the city by making possible cheap transportation; first, by the Erie and Oswego Canals, and later by the development of railroads.

In its place has grown a larger group of modern factories employing 60,000 workers and making such diversified products as air conditioning machinery, air cooled engines, tool steel, automobile gears, differentials and transmissions, jet engines, cans and can-making machinery, roller bearings, soda ash and by-products, fine wax candles, agricultural implements, high class chinaware, mincemeat, quality shoes, typewriters, electrical appliances and hardware, electric washing machines, steam clothes pressing machines, ladies' hand bags, cash carrying and conveying equipment, foundry and machine shop products, electronic equipment, radio and television receivers and transmitters and radar, and furniture.

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An ideal residential city, there are approximately 98,000 living units in the metropolitan area; apartment houses number over 100, there are 14 hotels, 35 theatres, 12 hospitals, 173 parks, 4 pay as you play and 2 public golf courses, 6 country clubs, and over 100 churches of various denominations. The educational facilities consist of 46 public schools, 18 parochial schools, and Syracuse University which includes the New York State College of Medicine, the New York State College of Forestry, and a College of Law. Two daily papers, two Sunday papers, five radio stations and two television stations cover the territory. Two trunk line railroads, over one hundred truck lines and a network of bus lines and State highways, and three airlines provide fast and regular service in all directions.

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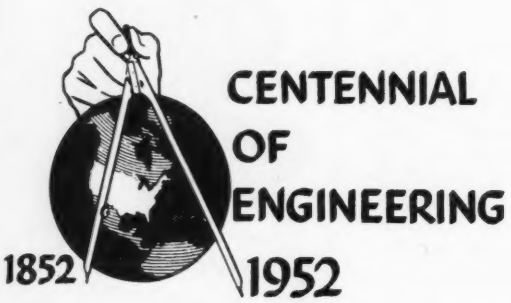

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PROGRAM

SEPTEMBER 8

MORNING SESSION—Historical Development of Lubrication Concepts

AFTERNOON SESSION—Fundamentals of Hydrodynamic Lubrication

SEPTEMBER 9

MORNING SESSION—Physics and Chemistry of Rubbing Solids—Basic Principles

AFTERNOON SESSION—Physics and Chemistry of Rubbing Solids—Technical Applications

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LUBRICATION SUMMARIZED

Oil Qualities Plus Additives Gives Performance—By Russell W. Meals, Sinclair Refining Co.

Submitted by R. R. Matthews, Chairman Kansas City Section, ASLE

"There is a limit to the ability of a straight mineral oil to give performance in all the applications to which a lubricant is applied in modern industry and modern engines. To extend this limit, the leaders in the petroleum industry have combined man-made chemistry with nature's to produce a highly refined, stable mineral oil compounded with selected additives in order that good performance might be obtained not only from the lubricants but also from the machines and engines produced and used in modern plants," said Russell W. Meals an automotive engineer for Sinclair Refining Co.

The lubricating oil used in the modern internal combustion engine is under more severe service than lubricants in other applications. Additive-type motor oils include many of the additives used in industrial oils, such as those used for gears, hydraulic systems, turbines and bearings. For this reason the three types of engine oil designed for various performance requirements were discussed, namely regular, premium and heavy duty. The regular type oil is used for moderate engine operation, so it is usually a straight mineral oil. The premium type motor oil is used to an advantage where more severe than moderate operating conditions are present and a proven resistance against oil oxidation and bearing corrosion is required. The third type, heavy duty, must give proven performance against oil oxidation, bearing corrosion and prevent engine sludge from forming under severe operating conditions.

Because of increased horsepower now developed by the automotive engines without an increase in weight or an increase in crankcase oil capacity has rapidly brought about the need of high performance motor oils, this requirement of high performance motor oil has given rise to the heavy duty additive motor oil being used in some of the new passenger car engines; while other lesser duty engines are satisfactorily lubricated with a light additive motor oil in the premium type classification. Because of the value to be received in the use of an additive motor oil, the sale of the additive type motor oil has surpassed the sale of the regular type motor oil.

The additives used for internal combustion engine crankcase oil are needed to counteract the ill effects of the compounds formed by modern fuels plus the high local temperatures involved. Acids, tars, peroxides and gums plus fuel additives are the products of combustion that find their way into the crankcase. These elements attack the operating parts of the engine while the insolubles settle out as varnishes, lacquers and sludge. To visually produce the effect of oil additives used in a motor oil a demonstration was made.

Drawing Compound Types—A Discussion of Function, Makeup, and Selection—By L. R. Tharp.

Submitted by M. J. Croghan, Secretary, St. Louis Section ASLE

The primary function of a drawing compound is separation of the surfaces of the cold worked metal and of the tool surfaces, permitting plastic flow of the metal without scratching, galling, or undue tool wear, and at the same time permitting just enough "drag" to provide stock control. Deep drawing surface pressures may go up to approximately 10,000 psi, ironing pressures to about 100,000 psi, and wire drawing and extrusion pressures may reach 450,000 psi. All these operations may therefore develop pressures far above the limits at which any lubricant now known could possibly provide fluid lubrication. However, the drawing compound should possess oiliness to reduce and to control the coefficient of friction. The compound must have film strength sufficient to resist high pressures and heat caused by work deformation, to prevent scoring and pickup for longer die life and prevention of rejects. To do these things, drawing compounds operate under conditions varying from boundary to solid lubrication. As secondary functions, drawing compounds may be called upon to provide rust or corrosion prevention on work, tools, and machines, and may provide heat transfer or a measure of insulation.

Soap is a common ingredient in all general types of drawing compounds. The soap will be selected for its wetting and emulsifying abilities, and adds film strength and lubricity. Petroleum suphonates, oleates, and stearates are most used. Petroleum sulphonates are low priced, have generally higher heat resistance and higher efficiency for emulsifying high viscosity mineral oils, but they are usually lower in their comparative values for film strength and lubricity. These products are often added to oil-bodied compounds to increase removability in aqueous cleaners. Stearates are milder than oleates, and their free fatty acids are preferred on copper and its alloys where staining is objectionable. Otherwise, oleic acid may be considered to possess superior lubricating qualities. Stearates and oleates are usually in the forms of potassium, sodium, or calcium soaps, according to properties desired. Potassium soaps are used in making the creamy, soft paste products. They are highly soluble and are used where water conditions are poor. Potassium soaps have 2 and 3 phase solubility—they can be used in a compound to be mixed with water, with oil, or with both oil and water. Sodium soaps are used in stiffer paste products. They are somewhat less soluble and more susceptible to adverse water conditions. They have 2 and 3 phase solubility, and the ability to form very stable mixtures with mineral oils. Calcium soaps are relatively insoluble in water, and for this reason may be used in a compound which must provide rust protection after drying. The lime soaps are very much effected by adverse water conditions. They gell easily, and for this reason are used in products in which little breakdown in consistency in relation to amount of dilution may be required. Calcium soaps have single phase solubility.

Fatty oils of animal, marine, or vegetable origin are used in all general types of drawing compounds. The fatty oils add wetting ability and lubricity, and are usually used in combination with other materials. The selection of a fatty oil depends on viscosity, heat resistance oxidation resistance, percentage of free fatty acid of required type, and compatibility and availability. Fatty oils are used to increase the lubricating qualities in mineral oil bodied compounds, and may be added for saponification by alkaline cleaners,

increasing removability. Mineral oils are used in many drawing compounds. They are removed easily by vapor degreasing or solvents, and the consideration of subsequent cleaning method will help to fix the percentage used in some formulation.

With the use of only two general types of raw material our possible combinations would be almost infinite. Then, if we would standardize on perhaps a dozen combinations with mineral oil and fatty oil the sole ingredients, the choice of exactly the correct material from the dozen compounds would still permit the possibility that for a particular operation we might not be certain, without trial, that our choice would be certainly the best combination to use. (Posing this relatively simple problem will serve to help explain why selection of a drawing compound depends on experience with all compounds, and why the first choice of compound and recommendation for dilution, for meeting the requirements of a particular operation, must often be amended after the drawing compound has been subjected to trial with the metal, tools, speed, etc., on that job.)

Chemical reactors, sulphur and chlorine compounds, are used in most heavy duty drawing compounds to add resistance to welding, or galling and buildup. Most such extreme pressure compounds are polar compounds, adding lubricity. Selection will depend on chemical and physical properties. Some of these compounds are extremely active even at room temperatures and therefore, cannot be used in all applications because of their staining tendencies. Sulphur is used in the so-called "active" form for its refrigerating and anti-welding properties.

Pigments have been used in cold working probably as long as the arts of metal working have been known. Probably the solid lubrication provided by iron scale and rust assisted some operations before it was realized that they did act as solid separators. Lime has been used since antiquity, but its disadvantages have sparked extensive research and experimentation on other materials which could perform the function of solid lubricant without excessive cleaning problems and which would be more nearly compatible with other solutions involved in processing. Readily soluble alkali crystals, formed by TSP, borax, and hexametaphosphate singly or in combinations for optimum size and structure, are often used as pigment in dry compounds. Graphite, mica, lead and zinc oxides and borates, a great variety of natural earths—nearly anything which remains a solid of suitable size and structure has been used in drawing compounds. Waxes are used in many drawing compounds, in water emulsions and solvent solutions. Chlorinated waxes are used as extreme pressure agents. Wax may provide adherence, relative slow movement when cool and faster speed when hot, and lubricity. Some aluminum drawing is done very well with wax alone.

Paste products comprise a general type of compound. The paste may be a simple soap and moisture combination, and this combination may contain pigments, fatty oils, and just about everything we have mentioned as ingredients of drawing compounds. The possibilities of formulation are unlimited. One of the many solid or semi-solid fatty materials may be used in paste products, materials such as tallow or sulphonated tallow. Oil-bodied drawing compounds are generally composed of a mineral oil of suitable viscosity as

principle ingredient. Under this classification we are grouping those products which provide an oily film, whether applied in neat form or diluted with water, oil, or oil and water. If the product is miscible with water, it must contain some emulsifier. Soap, sulphonated oils or esters, and petroleum sulphonates are used, and in addition such a compound may contain fatty oils, sulphur, and extreme pressure additives. If miscible with oil only, the product can contain the highest possible concentration of free sulphur and E. P. additives, with fats. The product may contain some soap or sulphonate to assist in removal with alkaline cleaners. If the soap content of the oil-bodied compounds remains at a low percentage, the vapor and solvent removal methods can be used very satisfactorily. Dry compounds, used as received, may be considered as a general type of drawing compound. Most usually used as draw box lubricants in wire and tube drawing, compounds of this type are predicated on soaps, pigments, sometimes fatty materials, and special compounds for E. P. quality. Metallic coatings, applied by hot dipping or electro-plating, are definitely drawing compounds, whether worked dry or with an additional lubricant. Copper, tin, zinc, lead, and cadmium are used extensively. Dry film products, those products intended for aplication to blanks in liquid form for drying to a dry film prior to working, are increasing in interest.

Selection of compounds will depend on the following: Type and severity of draw, the metal being worked, and the finish required. What will be needed to provide the separation, with stock control? If the metal is aluminum, will the total alkalinity and kind of alkaline present cause attack? Too high a percentage of free fatty acid, as oleic acid, will cause trouble on copper and its alloys. The speed of drawing, blank surface finish, and die clearances must be considered to arrive at the viscosity, or relative flowability, of the compound likely to be required. Tooling must be considered, from the standpoint of wetting, possible chemical action, and physical action of the compound. For example, chromium plated surfaces are hard to wet out, bronze may react with sulphur present, and some pigments might cause undesirable wear rates on tools.

Available methods of application must be considered. Is dipping, swabbing, or spraying to be used, or

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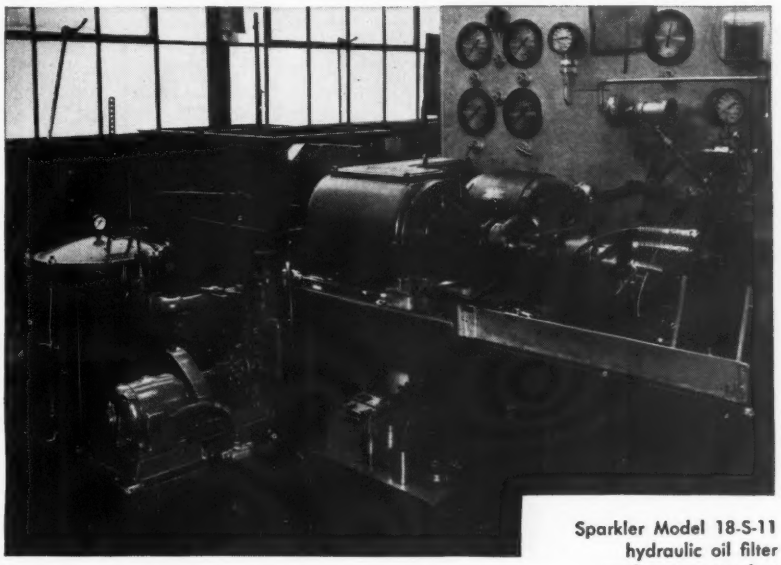

Sparkler Model 18-S-11 hydraulic oil filter used on test stand at Blackhawk Mfg. Co., Milwaukee, Wis.

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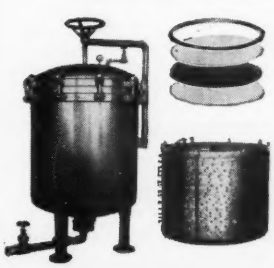

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is the compound to be applied by rolls or pumped in streams? Are heating facilities available if needed? How long an interval will there be between compound application and actual working? An important consideration is the subsequent treatment of the work, along with the interval before further processing. We should anticipate further drawing, with or without annealing, welding operations, painting without compound removal, and assembly in which the part might be too oily or gummy to handle. The prime consideration is usually cleaning. Drawing compound men are continually amazed at the shops which are set up to do a variety of work, but which have been equipped with only one cleaning method. Vapor degreasers will not successfully remove compounds high in soap or pigment content, although quite successful on mineral oils and greases. If you set up a shop to do more than a single specialty, then by all means consider the probability that you may be coping with removal of diverse types of compounds. It may not be economical to confine the shop to drawing compounds which can be removed by one cleaning method only.

Consideration must be made of mixing and application costs, extent of dilution of the compound, and another cost often disregarded, the considerable cost of cleaning. Can one product be diluted variously to do a wide variety of work, cutting storage and handling costs? Finally, after considering the facts of drawing efficiency, mixing and application costs, cleaning costs, uniformity, versatility, and employee acceptability, the decision on economy may take into account the price per pound.

Maintenance of Oil-Film Roll Neck Bearings—By S. Carson, Morgan Construction Co.

Submitted by J. P. Halwachs
Secretary, Youngstown Section ASLE

Good maintenance is preventive as well as corrective, and should be the responsibility of both the operating and mechanical departments. The results of good maintenance show up in weekly pay checks, profitable operations and improved morale. In its broader aspects, as applied to oil-film bearings, it is concerned with the proper mounting of the bearings in the mill-housings, the condition of the keeper-plates, clamps and latches; breaker blocks and rocker plates. Are these in good shape and

are they doing their job? Oil-film means oil; is it being introduced to the bearings at the specified temperature in the proper quantity and is the compound to be applied by rolls or pumped in streams? Are heating facilities available if needed? How long an interval will clean? This involves the circulating system, its pumps, filter, cooler and valves and the automatic controls of temperature, pressure and volume. All these points are part of preventive maintenance and will go a long way in reducing corrective maintenance.

Intelligence, cleanliness and good facilities are the foundation of good maintenance. The care of the bearings should be delegated to men who appreciate good machinery and take pride in keeping it right. Don't keep changing your bearing men; experience is invaluable. A good location for the bearing shop, with adequate facilities, is of next importance. Bearings should never be disassembled or stored on the mill floor. A separate area, removed from operations is desirable. If space is available in the roll shop this would be an ideal location, but regardless of location, the bearing crew should work in a heated building and comfortable surroundings. The area should have ample storage space for all the spare working bearings and, since it is impossible to maintain the bearings properly without sufficient spare parts, storage space should be provided for these, too. Oil and water seals, packings and other items can be stored in lockers and shelves. Besides this there should be a good-sized area for the mounting of bearings on the roll necks, and another for the complete dismantling and assembling of the bearings.

The ideal place to store a roll-neck bearing is on a roll neck. In the case of mills using large rolls there should be at least four Vee blocks, made of steel and lined with a suitable material that will not mark the roll bodies. Two newly ground rolls, fitted with their threaded half rings and having their neck keys on top, should occupy one pair of Vee blocks, while a pair of used rolls with their bearings would occupy the other pair of Vee blocks. As soon as possible, after taking a pair of rolls from the mill-housings, they should be turned in their bearings until the roll-neck keys are on top. This can be done with the chocks resting on the floor and by placing a steel pin in one of the holes in the periphery of the lock nut and pulling with the crane on a cable looped around this pin, thus causing the roll to rotate. The rolls can then be set in the Vee blocks. After the used rolls and the bearings have been allowed to cool the bearings should be transferred directly from the used rolls to the newly ground rolls without allowing the bearings to rest on the floor at all. Having the roll neck keys on top facilitates the entrance of the key in the sleeve keyway.

Where many rolls are changed during the same mill shutdown, such as on rod and merchant bar mills, long benches should be furnished for the handling of from sixteen to twenty rolls. These benches should be made of steel plate having 2-inch angles welded around the perimeter to serve as troughs which can be drained to buckets under the benches. This arrangement simplifies housekeeping. Welded to the benches should be the desired number of Vee blocks, suitably lined and equally spaced along the benches.

When a bearing is being transferred from one roll neck to another it is a good practice to examine the condition of the oil and water seals and the sleeve packing, and replace

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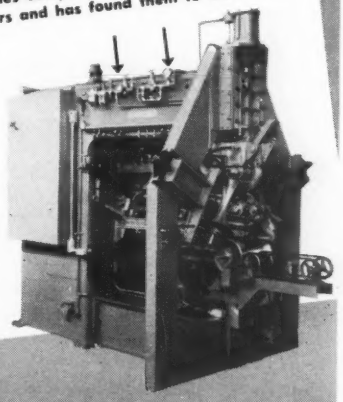

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any of these parts as might be necessary. At the same time an inspection should be made of the drain picket of the chock. This normally contains nothing but lubricating oil but, if particles of foreign matter are found there, the bearing should be dismantled for a general inspection.

What should determine the schedule of inspection? This would be decided by experience and conditions. A good basis is three months with variations to suit conditions. In no case should consideration be given to dismantling the bearings every time they are removed from the rolls. Once the period of inspection has been determined the cycle can be arranged so that a given number of bearings are dismantled each week or month, according to the number of bearings being used in the plant.

Each time the bearings are dismantled they must be thoroughly cleaned before being reassembled. To clean the chock properly it should be immersed in a water tank having steam and water inlets, a drain, and an overflow to the sewer. Using a fair amount of Oakite in the water the steam should be opened to boil the mill grease and scale off the chock. This can then be washed off through the overflow to the sewer before the chock is removed from the tank, and the final cleaning of the chock can be done with a solvent and high pressure air. Shallow pans should be furnished to contain solvents for the washing of all the other parts of the bearing.

The use of granular absorbents on the floor for greases and oils is general but should be avoided in any area where bearings are being assembled. The high pressure air line, used for cleaning the bearings, inadvertently pointed at the floor covered with one of these absorbents would probably necessitate another cleaning of the bearing parts. The floor can be kept clean by spreading paper on it, and then having this thrown away after the bearings have been assembled.

A lot of bearing trouble can be avoided by taking steps to correct faulty conditions before they go beyond working limits. In times past it was a common practice to make the radii of the screwdown and breaker-block alike. Now it is accepted that the radius of the concavity should be slightly greater than that of the convexity. The object of this design is to achieve a ball and socket condition that will permit the top bearing to follow the deflection of the roll-neck. After a period of service these parts can wear to the point where the contact between the two surfaces is so great that the traction of the one on the other can prevent the desired following of the roll deflection. This will cause concentration of load at the end of the bearing.

A rocker plate, making a theoretical line contact in the bottom of the mill-housing window, permits the bottom bearing to follow roll deflection. Broken or badly flattened rocker plates will also oppose the desired following of roll deflection and cause concentration of load at the end of the bearing.

Excessive thrust load in a mill can throw tremendous pressure on the thrust bearing and cause trouble, but this can be minimized with a little care. Mills are designed to operate with the axis of each roll parallel with its mate within reasonable tolerance. Operations cause wear of the mill-housing windows and the bearing chocks which, unfortunately, is not uniform. The amount of this wear that can be tolerated depends on the type of mill but, if it is allowed to progress beyond its limit, the attendant crossing of the rolls will set up a thrust in excess of the capacity of the thrust bearing. This situation is aggravated when a work roll is installed with unequal diameter necks. Off-setting the work rolls from the vertical centerline of the back-up rolls will help so long as the distances from the vertical centerlines of the rolls to the outsides of the chocks are within reasonable tolerances.

Electric welding around a mill can be a source of trouble if the welder's arc is remote from his ground. Evidence of this can be found on the surfaces of roll necks and the bores of sleeves in the form of small pits. Wherever this pitting is found on machinery it should be smoothed over. This pitting will be found in other parts of the mill machinery where there are minute clearances between two steel surfaces. Welders should be given specific instructions to place the ground as close to the arc as possible.

Finally, what is the cost per ton for bearing maintenance and replacement, and for lubrication? A careful record should be kept of the tonnages rolled on each bearing as well as the amount of lubricant used. The accounting system should show these figures at a glance, not only for the plant as a whole but for each individual mill.

LUBRICATION IN THE NEWS

MULTI-PURPOSE LUBRICANT: Excellent performance in both extremes of heat and cold, high resistance to water and anti-corrosiveness are major advantages claimed of a new multi-purpose industrial lubricant, Sotol, announced this week by Southwestern Petroleum Co. Sotol is said to retain its lubricative powers and not melt or run away even at a temperature of 1000 F. or more and to remain effective even to zero temperature. Creation of Sotol was made possible by use of a synthetically-formed base, largely a type of earth. Combined with the synthetic base are oil of the highest quality and other organic compounds. The lubricant has a clean, transparent amber color and is especially valuable to lubricate parts which are frequently submerged in water, exposed to rainfall or subjected to moisture condensation. Exhaustive field tests have been given in heavy-duty equipment used in many industrial operations—earth excavating, transportation, municipal engineering, logging, mining, oil drilling and producing, large-scale farming and ranching.

Southwestern Petroleum Co.
Fort Worth, Texas

LUBRICANT SPRAYER: For pre-lubrication of frictional parts in engine assembly and parts replacement, AP Parts Corp., manufacturers of Miracle Power and dgf-123, colloidal synthetic graphite lubricants, have packaged the products in "Pres-a-Lubers." The dgf-123 sprayer was designed for speedy, sure work as a final operation before placing a mechanical part where it belongs (or before storage). Dgf-123 is a colloidal synthetic graphite suspended in fluron. The fluron evaporates immediately after spraying and leaves a protective graphoid coating on the metal. After use, the top of the can is replaced over the nozzle to avoid accidental spraying. The Miracle Power Sprayer assures "wet" lubrication and can be safely used for domestic purposes as well as in the shops. The handy sprayer is used for lubricating all external moving parts of engines and machines (also recommended for internal parts alone or with dgf-123). It was designed for speed and ease of applying, allowing for plenty of clearance, so that hard-to-get places are reached with ease. Crown Can Co. produced the "Pres-a-Lubers." For further information write

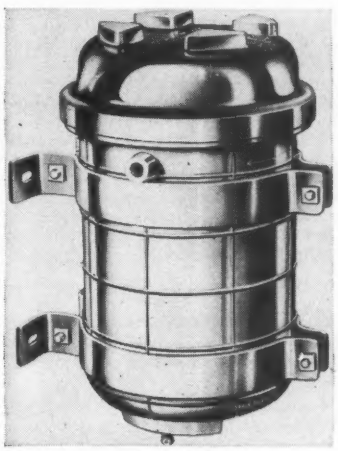
AP Parts Corp.
Toledo 1, Ohio

FILTER CATALOGUE: "Standard Filter Models PL-200" is the title of a new 4-page booklet containing data of use in enabling an engineer or plant executive to select the proper filter for a given industrial filtration problem. Thumbnail descriptions of standard model of Fulflo Filters for microscopic clarification of industrial liquids and gases, detailed description of Honeycomb Filter Tubes, essential data on single- and multi-tube filters of capacities from 6 to 60,000 gph, steel, brass, rubber lined steel and stainless steel models, and special applications are included. Copies of this booklet are available to readers on request.

Commercial Filters Corp.
18 W. 3rd St., Boston, Mass.

MOLYBDENUM LUBRICATION: *Abstracts, Bibliography and Case Histories of Liquimoly (Molybdenum Disulfide) Lubrication* is the title of a new Technical Bulletin now being offered by The Lockrey Co., stated to be the originators of the principle of liquefied molybdenum lubrication. The new Technical Bulletin No. 21-G contains a listing of the current reference-literature, with the important articles abstracted, a list of pertinent patents, and a summary of two years of case histories of field applications of Liqui-Moli lubricants. Forty-two references in all are quoted or listed, including the various investigations of the National Advisory Committee for Aeronautics on extreme high-pressure, high-temperature and high-speed applications, static friction tests, oxidation and fretting corrosion, the Bureau of Standards tests, and results obtained in the field with Liqui-Moly in such applications as stainless steel drawing, rolling, machining and assembly, ceramic plant uses, aircraft, and hot forging are described. Copies of this bulletin are available to readers on request.

The Lockrey Co.
Southampton, N. Y.



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CURRENT LITERATURE

Chemical and Engineering News, Vol 30, No. 10, March 10, 1952

THE PETROLEUM INDUSTRY—CONSUMER OF CHEMICALS. No. 3 IN A SERIES: CHEMICALS USED IN LUBRICATING OILS AND GREASES
Kuhn, W. E.—pp. 979-983

Use of additives enhance characteristics of lubricants, has boosted demand for chemicals over $100 million per year and the trend is still on the increase. Chemicals are also used in processing lubricants. The major solvent refining and solvent dewaxing process for lubricating oils are listed. Table 1 gives U. S. refiners producing lubricating oil. Lubricating oils are very amenable to further improvement by the use of additives. Different types of additives are discussed together with compounds that may be used. Silicone polymers may be used as anti-foaming agents. Table 4 gives summary in tons of chemicals required per month for lubricants.

Chemical Engineering, Vol. 59, No. 3, March, 1952

STRONTIUM HYDRATE
Anon.—pp. 198, 200

Strontium hydrate is now being made in pilot plant quantities by Westvaco Chemical Division. This compound is used in the manufacture of strontium greases which have many useful properties. They can be heated and cooled continuously in servide without any substantial change in consistency. They also resist the disintegrating effects of water at ordinary or elevated temperatures and the leaching action of hydrocarbons. They offer: superior protective action against moisture or salt spray corrosion; resistance to oxidation or breakdown upon exposure to elevated temperatures; good stability of grease structure when subjected to mechanical working.

Chemistry, Vol. 25, No. 6, February, 1952

AMERICAN INVENTORS' PATENTS IN 1951
Anon.—p. 47

The U. S. Patent Office found 1951 a busy year, issuing 44,356 patents or 1,284 more than during 1950. The weekly average output was 853, while for 1950 it was 828. The actual number issued each week hovered close to the weekly average for the year. Patents for new chemical compounds and improved processes for making old chemicals stand high in number, again indicating America's leadership in the chemical field. Notable among these chemicals are pharmaceuticals, dyestuffs, insecticides, fertilizers, fungicides, explosives, detergents, fuels, synthetic fibers, weed-killers, water softeners. Substitute metals may come into wider usage. In a recent government publication available from the U. S. Government Printing Office for one dollar is a list of 2,339 patents owned by the government which American businessmen can use without charge. Its title is Government-Owned Inventions for Free Use.

Chemie & Industrie, Vol. 67, No. 2, February, 1952

USE OF NAPHTENATES OF HIGHER ALKYLS IN PLACE OF LUBRICATING OIL FOR DELICATE APPARATUS
Kuwata, T., Noguchi, S., and Ando, H.—p. 261
(Bull. chem. Soc. Japan, Vol. 24, No. 3, July, pp. 157-160, 1951)

The alkyl esters of higher fatty alcohols and naphthenic acids constitute lubricants of the first order for very delicate machines. Properties are given.

Fuel Abstracts, Vol. 10, No. 6, December, 1951

METAL DRAWING LUBRICANTS FOR WIRE, TUBING AND SHEET STEEL
Smigel, W. A., Verner, H. G.—p. 68
(Iron Steel Engr., Vol. 28, pp. 97-102, 1951)

Sodium and metallic soaps are considered as well as straight soap lubricants, emulsion-type lubricants, petroleum oil lubricants, wire drawing grease lubricants, and lime substitutes.

Vol. 11, No. 1, January, 1952

OPERATION OF BUSHINGS IN CARBONIZED OIL
Wilson, W. R., and Wetherill, L.—p. 69
(Pap. 51-258 to Amer. Inst. Elect. Engrs., June, 1951)

GRAPHITE AS LUBRICANT
Clauch, E. S.—p. 24
(Iron Steel Engr., Vol. 28, pp. 58-60, Aug., 1951)

CAUSES OF DETERIORATION OF LUBRICANTS
Priston, H. E.—p. 50
(Pwr. Transm., Vol. 20, p. 993, Oct. 15, 1951)

Deterioration of a lubricant can take place either by chemical change in the lubricant itself or by contamination with adventitious material and products of combustion, both processes being governed by mechanical conditions.

Vol. 11, No. 2, February, 1952

COLLIERY LUBRICATION
Vacuum Oil Co., Ltd.—pp. 11-12
(London: The Company, 130 pp., 1951)

Part I deals with fundamental principles of lubrication and oil viscosity (resistance to change of shape). Bearing, gear, and cylinder lubrication is covered. Part II deals with the lubrication of surface machinery at collieries, including power generating plants, steam and electric winders, braking systems, ropes, etc., and the various classes of underground machinery, i.e., locomotives, haulage systems, conveyors, coal cutters, hydraulic props, etc. In Part III, the handling and storage of lubricants and the recovery and treatment of used oils are covered, and a chart at the end gives a list of oils and greases for various purposes. A series of diagrams and photographs of modern underground plant with their lubricating systems is also given.

EXTREME PRESSURE LUBRICANTS
Lewis, J. H.—p. 93
(Iron Steel Engr., Vol. 28, pp. 114-118, Sept., 1951)

SOLID PHASE STRUCTURE IN LUBRICATING GREASE
Mardles, E. W., and Puddington, I. E.—p. 94
(Pap. to Faraday Soc., July, 1951)

LABORATORY SCREENING OF MULTI-PURPOSE GREASES
Kipp, E. M., and Zeiler, C. A.—p. 94
(Iron Steel Engr., Vol. 28, pp. 107-113, Sept., 1951)

STRUCTURE OF ALUMINUM GREASES
Dean, W. K.—p. 95
(Inst. Spokesman, Vol. 15, pp. 12-21, Sept., 1951)

CUTTING OILS
Williams, A. E.—p. 96
(Min. Mag., Vol. 85, pp. 279-282, Nov., 1951)

OXIDATION OF MINERAL OILS
Hagethorn, N. E. M.—p. 215
(Electrotechniek, Vol. 29, pp. 471-475, Dec. 6, 1951)

A method of assessing the resistance of mineral oils to oxidation is described, in which the quantity of oxygen absorbed, electrical losses, viscosity, and change of color during oxidation are described. Full details are given of the apparatus used.

Industry and Power, Vol. 62, No. 3, March, 1952

SPICER FINDS ANSWER TO LUBRICATING LARGE EXPENSIVE MACHINES
Lohbauer, R. C.—pp. 79-81

After several extensive studies made to determine the cause of excessive down time on machine tools, Spicer Mfg. Corp. decided that 75 per cent was the result of improper and inadequate lubrication. Lubrication procedures were standardized, as described in the article. Savings were as follows: 1. $1280 annually in direct labor. 2. $500 annually in replacement parts and, 3. $4667.52 by eliminating full time maintenance man.

Institute Spokesman, Vol. 15, No. 11, February, 1952

MILITARY LUBRICANTS—THEIR CONSOLIDATION AND REQUIREMENTS
Kelley, C. W.—pp. 20-21, 23, 25-26

The necessity of greater correlation between service-performance and laboratory performance tests, together with refinements of laboratory methods for greater reproducibility is stressed. Sources of military petroleum specifications are listed. An example of consolidation of specifications is the case of corrosion preventives where fourteen specifications have been combined into three specifications, having seven grades. The Army believes it will be possible to develop a single all-purpose, all-temperature automotive and artillery grease which would be the principle item of field supply. Fluorinated oils, bentone, synthetic lubricants, and gear oils are also considered.

Journal of the Institute of Petroleum, Vol. 38, No. 338, February, 1952

BEARINGS, LUBRICANTS, AND LUBRICATION. A DIGEST OF 1950 LITERATURE
Anon.—p. 109A
(Mech. Engrg., Vol. 73, No. 11, pp. 892-6, Nov., 1951) ....

Seventy-two papers are cited.

Lubrication, Vol. 37, No. 12, December, 1951

GREASE LUBRICATION AT HIGH SPEEDS
Anon.—pp. 141-148

The foregoing apparatus as designed for evaluating greases on anti-friction bearings, and the test procedures used have produced some very interesting data on grease lubrication at speeds up to 35,000 r.p.m. By use of this test apparatus and procedures it would seem to be possible to predict with a reasonable degree of accuracy, the expected performance of a grease in service installations. The knowledge that greases can be made to supply satisfactory lubrication at high rotative speeds opens a broader field for this type of lubrication. Further study of grease lubrication of anti-friction bearing under even more severe test conditions should produce additional interesting data. It will be very desirable to have such data to prove or disprove the suit-

ability of grease lubrication for bearings running as high as 100,000 r.p.m. at high ambient temperatures.

February, 1952
Vol. 38, No. 2,

LUBRICATION OF RAILROAD MOTIVE POWER

Anon.—pp. 13-24

Steam came first. Then the Diesel electric locomotive. Steam cylinders, valves, and valve seats require lubrication in the steam locomotive. This is internal lubrication; it is maintained automatically by mechanical force feed lubrication actuated by the valve gear, or automatically from a hydrostatic lubricator located in the cab. Valve oils, compounding, application are considered. Diesel motive power growth (railroad) posed problems such as:—1) Ring sticking and breakage. 2) Valve sticking and blowing. 3) Wear. 4) Metal corrosion, particularly silver. 5) General engine cleanliness. 6) Rusting. 7) Viscosity build-up. Diesel oil must possess:—1) Oxidation stability to reduce deposit formation and withstand viscosity build up. 2) Adequate film strength to reduce wear of moving parts to a minimum. 3) Corrosion resistance. 4) Dispersion and detergency. 5) Certain degree of rustproofing. Selection of base stock from best available crude sources, refining to remove undesirable properties, incorporation of additives to enhance desirable characteristics has produced improved oils.

Journal of Commerce, New York,
Vol. 231, No. 17,608, March 24, 1952

RESEARCH ENHANCING SERVICE, PROPERTIES OF LUBRICATING OILS

Kuhn, W. E.—pp. 15, 22

Current annual expenditures of the petroleum industry on research devoted specifically to the development of lubricating oil and greases amount to almost $1.00 for each motor vehicle registered in the U. S. Petroleum companies furnish a sizeable portion of the raw materials required for lubrication additives including: petroleum sulfonates, petroleum naphthenates, olefins, certain aromatics, wax and alkylating stock. Lubricating oil additives can arbitrarily be divided into two groups: a) Those which are useful for their properties as associated with the phenomenon of oil oxidation such as anti-oxidants, anti-corrosives and detergents and/or dispersion agents. b) Those which are added to an oil to improve some physical property such as viscosity index, pour point, film strength, rust protection and foaming characteristics.

Mechanical Engineering, Vol. 74, No. 2,
February, 1952

EXPERIENCES WITH SYNTHETIC LUBRICANTS

Brophy, J. E.; Zisman, W. A.; Kipp, E. M.; Parsons, J. L.; Stutson; Sweatt, C. H.; and Langer, T. W.—pp. 162-164

The antiwear action of the LB and 50-HB fluids is due basically to the difference in chemical structure between polyglycols and hydrocarbons and is exhibited only when operating conditions are such as to permit suitable chemical reactions with the metallic surfaces. Polyglycols have remained substantially unchanged after long-time service in exactly the same system where petroleum oils exhibited sludge formation and other deterioration in a comparatively short time. Nevertheless, it is recognized that

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In accordance with the American Society of Lubrication Engineers Constitution each industrial member company names one man as its official representative. The names of men thus appointed are indicated in italics.

once pyrolysis and oxidation starts above approximately 550 F, the polyglycols can decompose rather rapidly. Viscosities of the polyglycols under consideration are practically independent of the rate of shear. Corrosion is the most frequent and serious trouble encountered with polyalkylene glycols and additives are often recommended. Additional discussions of the paper "Some Industrial Experiences With Synthetic Lubricants" by Sweatt and Langer, which appeared in the June issue of "Mechanical Engineering," is given.

Revue de L'Institut Francais du Petrole et Annales des Combustibles Liquides, Vol. 7, No. 1, January, 1952

LUBRICATION OF BALL BEARINGS

Brand, J.—pp. D-13, D-14
(Commission Technique de la Lubrication des Charbonnages de France, Sept. 26, 1950)

After having taken up the rule of lubrication in ball bearings the author points out three methods of lubrication, greasing, oiling, atomizing oil.

SAE Journal, Vol. 60, No. 4, April, 1952

AIR CLEANER-OIL FILTER PROTECTION CRITICAL FACTOR IN ENGINE WEAR

James, W. S., Brown, B. G., and Clark, B. E. —pp. 18-26

This is somewhat in the way of a progress report on engine wear and how to reduce it by using air cleaners and oil filters. These two pieces of equipment are very important and adequacy of both gives an important increase of engine life to insure properly controlled wear of bores, rings and bearings. The systems of oil circulation in an engine should receive more study. Abrasive dirt is very harmful. Paved highway tests were made to establish basis for judging the amount of wear. Table one shows oil contamination. Results of the study are given in a series of graphs.

Oil and Gas Journal, Vol. 50, No. 47, March 31, 1952

LUBE OIL KEPT UNDER PRESSURE BY DRILLING EXPLORATION CO.

Anon.—pp. 106-107

A set of closed vessels have been adapted by Drilling Exploration Co. for lubricating oil in such a manner that contents are under pressure as long as any oil remains in the containers. This conversion prevents spills and use of measuring cans and buckets, and delivers the lube oil through oil-proof hose and pipe lines directly to the engines, where makeup can be done by opening a gate valve.

Oil Daily, Vol. 1, No. 111, March 11, 1952

1951 LUBRICANT DEMAND SETS ALL-TIME HIGH

Anon.—p. 6

Total demand for lubricants advanced 12.5% in 1951 to set a new all-time record high. Official figures just released by the Bureau of Mines disclose that demand soared to 59,721,000 barrels last year, compared with 53,105,000 in 1950.

Oil Engine and Gas Turbine, Vol. 19, No. 221, November, 1951

LUBRICATION COSTS

McArd, G. W.—pp. 274-276

Good operational practice with transport engines, as with stationary ones, can effect valuable economies. Oil purification is a key to success. The question is

often raised as to whether oil which has been thus reconditioned is really suitable for engine lubrication. The original lubricating properties of a good oil in no way suffer by use and re-use after thorough purification has been properly carried out. Methods of oil purification by means of filtration and centrifuging are explained.

***Petroleum Times*, Vol. 55, No. 1419, December 28, 1951**

SYMPOSIUM ON GEAR LUBRICATION

Anon.—p. 1171

The Institute of Petroleum is to hold a symposium on the Lubrication of Gears and the Testing of Gear Lubricants at London, on Wednesday, February 13. The papers and authors are listed.

PROGRESS IN THE SCIENCE AND ART OF LUBRICATION

Paterson, E. V.—pp. 1185-1187

Topics discussed include molybdenum disulphide, glycerine as a lubricant, aluminum pistons and chromium plating, grease testing machines, silicones as lubricants, and tailor-made lubricants. (9 references.)

Vol. 56, No. 1421, January 25, 1952

PHYSICAL CHEMISTRY OF LUBRICATING OILS

Kelly, C. I., pp. 53-54

The book by A. Bondi with the above title (Reinhold, 1951) is reviewed. Over 700 selected researches into lubricants—some of them unpublished—are presented systematically in eight chapters with these titles: I. Pressure-Volume-Temperature Properties; II. Rheology; III. Surface Phenomena; IV. Optical and Electrical Properties; V. The Hydrocarbon Type Analysis of Lubricating Oils; VI. Phase Equilibria; VII. Reaction Kinetics; and VIII. Synthetic Lubricants.

***Plant*, Vol. 5, No. 3, March, 1952**

DEVICE APPLIES WIRE ROPE LUBRICANT UNDER PRESSURE

Anon.—p. 62

An air spray type lubricator, claimed to be highly efficient for applying light bodied oils, is described. Manufactured by J. A. Roebling's Sons Co.

Vol. 5, No. 4, April, 1952

RECONDITIONING OF LUBE OIL CAN BE A PROFITABLE MAINTENANCE UNDERTAKING

Cleaveland, D. M.—pp. 54-55

Five common causes of lubricating oil contamination in industrial installations are as follows: heat, oxygen, dirt, moisture, and metallic oxides. In internal combustion engines, fuel dilution may also impair oil effectiveness. Settling, centrifuging, filtration, adsorption, and vaporization are main methods of reconditioning or reclaiming used lubricating oils. Each is briefly considered.

***Plant Engineering*, Vol. 5, No. 12, December, 1951**

RUST PREVENTIVE LAYOUT AT LINK-BELT'S DODGE PLANT

Anon.—pp. 88-89

To protect bearings from staining and rusting, Link-Belt has engineered a modern preventive system at its Indianapolis plant. Careful selection of rush preventives and method of application at each stage of manufacture have resulted in long-life protection.

Vol. 6, No. 1, January, 1952

ADDITIVE PLANT LUBRICANTS — HOW THEY HELP WITH LUBE PROBLEMS: III—ANTI-FOAM ADDITIVE, GRAPHITE, DETERGENT OILS, EXTREME PRESSURE LUBRICANTS, TURBINE OILS

Young, T. R.—pp. 69-71, 128

The first part of this three-part series on additives covered viscosity index improvers and oxidation inhibitors. Part II discussed pour depressants, corrosion inhibitors, oiliness agents and tackiness agents. The present article covers graphite, antifoam additives, detergent oils, extreme pressure lubricants and turbine oils, noting places where each is most effectively used.

***Materials & Methods*, Vol. 35, No. 1, January, 1952**

FLUIDS FOR HYDRAULIC SYSTEMS—THE BASIC TYPES AND WHERE TO USE THEM

Rose, K.—pp. 100-102

The exacting requirements of hydraulically actuated power and control mechanisms narrow the choice of fluid to a relatively small group of materials. Selection factors include low volatility, ideal viscosity (low or high, at whatever temperature is best), good service life, weight as low as consistent with requirements, nonflammability. Types of hydraulic fluids are water-base, oil-base, halogenated organic liquids, liquid esters.

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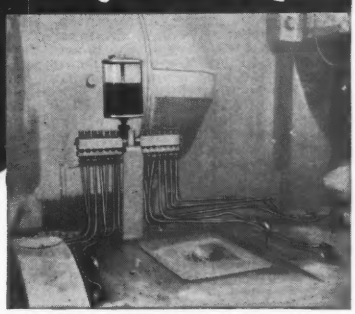

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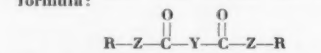
PATENT ABSTRACTS
—oils and lubricants

Lubricants and Additives for Lubricating Oils and Greases—Patent #2,587,642—John M. Musselman and Herman P. Lankelma, assignors to The Standard Oil Company.

Mineral lubricating oils and greases which contain an amount to inhibit their deterioration in use of the reaction product of an unsubstituted fatty acid containing from about 12 to about 18 carbon atoms and having an iodine value of not over 70, reacted with about 20% to about 35% of a phosphorus sulfide selected from the group consisting of P_2S_5 and P_4S_3 at about 300 F. for about one hour, said reaction product containing a sulfur-to-phosphorus ratio higher than that of a thiophosphate and being suitable to inhibit the deterioration of lubricating oils and greases in use.

Lubricating Compositions—Patent #2,588,273—Arnold J. Morway and Paul V. Smith, Jr., assignors to Standard Oil Development Co.

A lubricating composition consisting essentially of a lubricating oil containing at least 25% by weight based on the total composition of a sulfur-containing ester of a dibasic acid having the general formula:



wherein Y is a radical selected from the group consisting of divalent aliphatic hydrocarbon radicals containing from 2 to 8 carbon atoms and divalent aliphatic hydrocarbon radicals containing from 2 to 8 carbon atoms and having a thioether linkage therein, R is an aliphatic hydrocarbon radical containing from 8 to 20 carbon atoms, the sum of R + R being from 14 to 40, Z is a material of the class consisting of oxygen and sulfur, when Z is sulfur, Y being a divalent aliphatic hydrocarbon radical containing from 2 to 8 carbon atoms per molecule, thickened to a grease consistency with the lithium soap of a substantially saturated fatty acid.

Lubricating Composition—Patent #2,588,279—Rosemary O'Halloran, assignor to Standard Oil Development Co.

A blended grease composition which consists essentially of a mixture of two component greases, one component being from 95% to 50% by weight based on the weight of the total composition of a grease formed from a mixture of the sodium and barium soaps of a high molecular weight substantially saturated fatty acid, the mol ratio of the sodium soap to the barium soap being from 1 to 1 to 25 to 1, and the other component being from 5% to 50% by weight based on the weight of the total composition of a grease formed from a mixture of the sodium soap of a high molecular weight substantially saturated fatty acid and the sodium salt of a low molecular weight organic carboxylic acid, the mol ratio of the soap and salt being from 1 to 1 to 4 to 1.

Lubricating Grease—Patent #2,588,280—Rosemary O'Halloran and John J. Kolfenbach, assignors to Standard Oil Development Co.

A lubricating grease composition which consists essentially of a lubricating oil thickened to a grease consistency with from 10 to 20% of a mixture of the sodium and barium salts of a mixture of substantially saturated aliphatic acids, said mixture of acids containing from 10 to 90% by weight of an acid in the C_{16} to C_{22} range and from 10 to 30% by weight of an acid having 4 less carbon atoms than the acid present in the predominant amount.

Manufacture of Block Grease — Patent #2,588,326—Albert B. Ogden, Richard A. Butcosk, and Raymond C. Williams, assignors to Socony-Vacuum Oil Co., Inc.

In a process for cooking a mineral lubricating oil fraction with materials selected from the group consisting of (1) fatty acid soaps and (2) fatty acids together with saponifying compounds to manufacture a block grease containing, as the predominating constituents thereof, mineral lubricating oil and a fatty acid soap, the improvement which comprises including in the cooking batch a small amount, less than about 1% by weight, of an ester of a dibasic carboxylic acid with an aliphatic alcohol.

Mineral Oil Compositions—Patent #2,588,412—Albert G. Rocchini, assignor to Gulf Research & Development Co.

An improved mineral oil composition comprising a major amount of a mineral oil and dissolved in said oil a minor amount of a water-insoluble reaction product obtained by a process comprising maintaining a mixture of about equi-molecular quantities of mixed alkenyl-substituted succinic acid anhydrides in which the alkenyl substituents contain an average of about 10 to 12 carbon atoms and an amine selected from the group consisting of trimethylamine, triethylamine, triamylamine, triethanolamine, tribenzylamine, tristearyltriethanolamine, triethanolamine-ethylphosphatidic acid and pyridine, at an elevated reaction temperature of about 250 F. for about 5 minutes, the amount of said reaction product sufficient to impart corrosion-inhibiting properties to said composition.

Printed copies of patents are available from the Patent Office at twenty-five cents each. Address the Commissioner of Patents, Washington, D. C., for copies and for general information concerning patents.

From Official Gazette—Vol. 655, No. 2; Vol. 656, Nos. 1, 2, 3, 4; Vol. 657, Nos. 1, 2, 3, 4.

Prepared by ANN BURCHICK

Grease—Patent #2,590,786—John Walter Nelson, assignor to Sinclair Refining Co.

A grease composition consisting essentially of a lubricating oil thickened by a mixture of high molecular weight microcrystalline wax acids produced by substantially complete oxidation of microcrystalline wax containing 34 to 55 carbon atoms per molecule which is characterized by extreme water insolubility and by a saponification number less than about 200 and which predominates in monocarboxylic acids having ain apparent chain length exceeding eighteen carbon atoms per molecule.

Grease Composition—Patent #2,590,801—John W. Teter and John Walter Nelson, assignors to Sinclair Refining Co.

A grease composition comprising a lubricating oil thickened by the soaps of a high molecular weight microcrystalline wax acid mixture produced by substantially complete oridation of microcrystalline wax containing 34 to 55 carbon atoms per molecule which is characterized by extreme water insolubility and by a saponification number less than about 200 and which predominates in monocarboxylic acids having an apparent chain length exceeding eighteen carbon atoms per molecule.

Lubricating Oil Additives—Patent #2,584,977—John D. Bartleson, assignor to The Standard Oil Co.

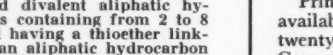
As a composition for stabilizing mineral oil which is subject to oxidative deterioration a mineral oil-dispersible cation radical derivative of a reaction product of one mole of an aliphatic nitrile having from about 12 to about 18 carbon atoms in the molecule and 0.1 to 1.0 mole of a phosphorus sulfide reacted at a temperature of about 400 F. for about ½ hour to form a mineral oil-dispersible reaction product, said derivative containing from 0.25 to 6.0 equivalents per mole of the sulfide in the sulfide-nitrile reaction product of an alkali metal cation.

Lubricating Compositions Containing Highly Basic Metal Sulfonates—Patent #2,585,520—Paul R. Van Ess and Hulbert E. Sipple, assignors to Shell Development Co.

A mineral lubricating oil comprising a major proportion of a mineral lubricating oil and a minor portion of an oil-soluble highly basic divalent metal petroleum sulfonate of a strongly basic metal of group II of the periodic table, which has a freee basicity substantially greater than that of the corresponding monobasic divalent metal petroleum sulfonate ($RSO_3.M.OH$—wherein M is the divalent metal and RSO_3 is petroleum sulfonate), the highly basic petroleum sulfonate being prepared by intimately contacting about one mol proportion of an oil-soluble petroleum sulfonate of a strongly basic metal of group II of the periodic table dissolved in a water-immiscible organic solvent therefor, which is non-reactive with divalent metal alcoholates, with at least about two mol proportions of an alcoholate of a strongly basic divalent metal of group II of the periodic table and a lower molecular weight monohydric simple alcohol of 1 to 4 carbon atoms under substantially non-aqueous conditions, subsequently treating the solvent solution of the resulting product with water to hydrolyze the alcoholate to an hydroxide and recovering the resulting oil-soluble highly basic divalent metal petroleum sulfonate from residual water and alcohol.

Hydrocarbon Oil Composition—Patent #2,585,813—John P. McDermott, assignor to Standard Oil Development Co.

A mineral oil composition having incorporated therein an oxidation inhibiting amount of a mixed acid anhydride of the formula—



wherein R is a hydrocarbon radical and R'is a hydrocarbon radical of the group consisting of aliphatic and aromatic hydrocarbon radicals, and R and R' each contain 1 to 30 carbon atoms.

Lubricating Composition—Patent #2,585,820—Le Grand Morell and Amos T. Knutson, assignors to The Dow Chemical Co.

A composition of matter comprising a mineral lubricating oil and a relatively small proportion of a substantially nonvolatile chlorinated paraffin hydrocarbon as essential ingredients.

Lubricating Oil Composition—Patent #2,585,877—Hastings S. Trigg, Henry D. Norris, and Ralph V. White, assignors to Socony-Vacuum Oil Co., Inc.

A mineral oil containing a minor amount, sufficient to improve the antiwear properties and the cutting efficiencies thereof, of an ester of a trialkylammonium acid salt of a hydroxy aliphatic dicarboxylic acid and a primary, aliphatic, monohydric alcohol containing between about 12 carbon atoms and about 31 carbon atoms per molecule; the alkyl radicals in the trialkylammonium group of said trialkylammonium salt containing up to six carbon atoms per radical.

Cutting Oil—Patent #2,591,570—Samuel Manilych and Lee L. Lambert, assignors to Socony-Vacuum Oil Co., Inc.

A compound oil consisting essentially of a mineral oil base of lubricating grade containing about 0.9% active sulfur and commercial hydroabietyl alcohol in amount of 0.1 to about 10% effective to increase drill life.

High Temperature Lubricating Greases—Patent #2,591,586—Arnold J. Morway and Alfred H. Matuszak, assignors to Standard Oil Development Co.

A process of preparing a lubricating grease composition having outstanding utility at elevated temperatures which comprises the steps of combining with one of two portions of a lubricating oil to be used as the liquid phase, from 1 to 4 molar proportions of a material selected from the class consisting of acrolein, acrolein dimer and mixtures of acrolein and acrolein dimer, adding to the mixture with agitation an aqueous solution containing from 2.5% to 5% by weight,

based on the weight of the material of the class of a metallic hydroxide, thereafter adding from 1 to 4 molar proportions of a substantially saturated fatty acid containing from 12 to 22 carbon atoms per molecule, and additional metallic hydroxide solution to insure complete saponification of said fatty acid, raising the temperature of the resulting mixture, adding the second portion of the lubricating oil, and cooling the resulting mixture to obtain a finished grease composition.

Brick Grease Composition—Patent #2,591,630—Lorne W. Sproule and Laurence F. King, assignors to Standard Oil Development Co.

A block lubricating grease composition for high temperature operation consisting essentially of about 3 to 6 parts of mineral lubricating oil of viscosity between 80 and 125 SSU/100 F. and 1 to 6 parts of mineral lubricating oil of viscosity between about 2000 and 5000 SSU/100 F., and 8 to 40% by weight, based on the total composition, of soda base soap.

Process of Forming a Machining Lubricant Upon Molybdenum — Patent #2,591,777 — Dwain B. Bowen, assignor, by mesne assignments, to the United States of America.

The process of machining molybdenum which comprises applying carbon disulphide upon the surface of molybdenum work being machined by a machine tool and utilizing the heat generated by said tool to chemically form a lubricant coating upon the work surface of said molybdenum.

Mineral Oil Composition—Patent #2,592,204—John F. Socolofsky and Ralph V. White, assignors to Socony-Vacuum Oil Co., Inc.

A mineral oil which normally permits rusting and staining of ferrous metal surfaces in the presence of salt water, containing a minor proportion, sufficient to prevent said rusting and staining of an ester product of malic acid obtained by reacting malic acid with a short-chain, aliphatic alcohol having between about six and about eight carbon atoms per molecule, and with a long-chain, aliphatic alcohol having at least about twelve carbon atoms per molecule, in a molar proportion of about 1:8-1.6:1.2-0.4, respectively, at a temperature varying between about 120 C. and about 140 C., concurrently removing the water of esterification as it is evolved; adding a hyrocarbon solvent which forms an azeotropic mixture with water, removing essentially all of the remaining water of esterification formed in the reaction by azeotropic distillation at a liquid temperature varying between about 130 C. and about 150 C.; treating the resulting reaction mixture with a basic nitrogen compound selected from the group consisting of ammonia and organic amines, at a temperature varying between about 90 C. and about 100 C.; and separating the thus treated ester product from said hydrocarbon solvent.

Manufacture of Grease Compositions—Patent #2,588,556—Robert J. Moore and Walfrid Saarni, assignors to Shell Development Co.

The method of making grease compositions from soaps of the group consisting of alkali metal soaps, alkaline earth metal soaps and mixtures thereof comprising forming a slurry of the soap and lubricating oil said soap being present in an amount sufficient to form a grease, heating said slurry to a temperature of 180-250 C. until a homogeneous noncrystalline mixture has formed and thereafter cooling said grease to its gelation phase and heat-treating said grease below 172 C. but above 100 C. to produce a stable homogeneous grease.

Forging Lubricant and Method of Using Same—Patent #2,588,625—Warren E. Ferner, George Alexander, John Robinson, and Walter E. Streeter, assignors to Aluminum Company of America.

A slurry for application to slugs to be forged or pressed consisting essentially of water, from about 3 to 20% of finely divided solid undissolved mineral lubricating material which is stable at the forging or pressing temperature to which the slugs are subjected, from about 0.25 to 4% of an organic adhesive uniformly distributed throughout the slurry which is soluble in water or capable of forming a colloid or suspension therein and which does not

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form a carbonaceous film during the drying and preheating operations preparatory to forging or pressing, and from 1.5 to 20% of a compatible inorganic water-soluble salt inert toward said adhesive and stable at the forging or pressing temperature, the total amount of said lubricating material, organic adhesive and salt constituting from 10 to 30% by weight of the slurry.

Nonfoaming Oil Composition Containing Polymeric Silicone — Patent #2,589,317 — David W. Young and Salvatore George Gallo, assignors to Standard Oil Development Co.

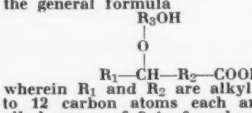
An improved oil composition comprising a major proportion of a hydrocarbon oil of the gas oil to lubricating oil viscosity range, having dissolved therein a foam-reducing amount of an oil-soluble solid gel repolymerization product of a liquid hydrocarbon-silicone polymer, said repolymerization product having been formed through the use of a bromine-containing catalyst at a temperature of about 0 to 200 C., said bromine-containing catalyst being selected from the group consisting of elemental bromine and Friedel-Crafts metal bromides.

Lubricant Stick — Patent #2,589,582 — Peter Strughold and Joseph F. May.

A heat resistant solid composition combined of 80 to 90% amorphous graphite and 20 to 10% "bakelite" combined under heat at a temperature of at least 250 F. and pressure of at least 15,000 pounds per square inch for a period of approximately three hours to form a linear member for engagement with the flange of a locomotive wheel to effect a non-liquefying lubricating coating thereon.

Lubricating Grease Composition — Patent #2,589,973—Paul V. Smith, Jr. and Arnold J. Morway, assignors to Standard Oil Development Co.

A lubricating grease composition consisting essentially of lubricating oil thickened to a grease consistency with 3 to 40% by weight, based on the total composition, of metal soap of aliphatic carboxylic acid, said metal soap comprising at least one third part of a soap of an acid having the general formula



wherein R_1 and R_2 are alkyl groups of 3 to 12 carbon atoms each and R_3 is an alkyl group of 2 to 6 carbon atoms.

Complex Soap Greases—Patent #2,583,607 —Aurelio F. Sirianni and Ira E. Puddington, assignors to The Honorary Advisory Council for Scientific and Industrial Research.

A lubricating grease composition consisting essentially of a mineral base lubricating oil thickened to a grease consistency with 5 to 20% by weight, based on the total composition, of a complex polyvalent metal salt of one molar part of C_{12} to C_{24} fatty acid and 3 to 15 molar parts of C_2 to C_6 dibasic carboxylic acid, said salt having its normal water content replaced by said oil to form a stable gel structure.

Lubricant—Patent #2,584,085 — Fred H. Stross, assignor to Shell Development Co.

A composition comprising the following ingredients in the stated proportions.

	Parts by wt
Oleaginous substance	5-20
Inorganic grease-forming gel	1
Polymerization product of an organi-silicon halide	0.5-5

said polymerization product being sorbed on said gel, the latter being dispersed in the oleaginous substance and having a structure substantially the same as originally formed.

Lubricating Fitting for Vehicle Springs—Patent #2,584,119—Vito Fresolone.

A grease fitting for automobile springs enclosed in metal spring covers provided with a lubrication hole comprising: a channel section the web of which is provided with a central hole in which is mounted a stud having a grease passage therethrough, one end of the stud projecting beyond one face of the web to extend into the lubrication hole of the spring cover and the other end of the stud having a head to engage with a grease gun, and a U shaped yoke to extend over the spring and downwardly along the sides thereof and through holes in the ends of the web of the channel section, the ends of said yoke being threaded, and nuts screwed on to the yoke for clamping the spring cover and spring tightly between the channel section and the yoke to maintain the plug of the stud firmly seated in the lubrication hole of the cover.

Manufacture of Lubricating Oils from Shale Oil—Patent #2,586,590—Paul Woog, assignor to Compagnie Francaise de Raffinage.

In a process of treating crude shale oil to produce a high grade lubricant therefrom, the steps of fractionating said crude shale oil to remove paraffin fractions therefrom, adding aromatic hydrocarbons to the residual portion of said oil, and then heating the oil in the presence of a Friedel and Crafts catalyst to simultaneously polymerize and arylate unsaturated constituents of said oil to convert them into compounds having improved lubricating properties.

Rust Preventing Lubricant—Patent #2,587,545—Lorne W. Sproule and Laurence F. King, assignors to Standard Oil Development Co.

A mineral lubricating oil containing dissolved therein 0.2 to 3.0% of a sorbitan monoester of an aliphatic monobasic carboxylic acid having 16 to 18 carbon atoms per molecule and 0.2 to 3.0% of a glycol half-ester formed by esterifying one molecular proportion of a glycol containing 3 to 5 carbon atoms per molecule with one molecular proportion of an essentially fatty acid material in which the predominating acids are fatty acids containing from 10 to 16 carbon atoms per molecule.

Rust Inhibiting Composition—Patent #2,587,546—Alfred H. Matuszak, assignor to Standard Oil Development Co.

A rust inhibiting composition consisting essentially of a mineral lubricating oil and about 0.5 to 1% of a hydroxy-aliphatic amine salt selected from the group which consists of the oleic salts of mono-, di-, and tri-methylol amino methanes.

Extreme Pressure Lubricant—Patent #2,592,497—Walter E. Waddey and Elmer B. Cyphers, assignors to Standard Oil Development Co.

A lubricating composition which comprises a major amount of a lubricating oil base stock and a minor amount of a mixture of about 2½% to 10% by weight of a 50% oil concentrate of a P_2S_5 treated degras analyzing from about 5.01% to 7.98% sulfur and from about 1.0% to 2.51% phosphorus, and about 5% to 7.5% chlorinated wax containing about 40% chlorine.

Cutting Oil Concentrate and Method of Making Same—Patent #2,592,624—Franklin Veatch and John G. Partch, assignors to The Standard Oil Co.

The reaction product of "motor polymer" and sulfur monochloride reacted at a temperature below 50 C. in the presence, from the beginning of the reaction, of a paraffin oil diluent and a substantially anhydrous alkaline base not readily reactive with sulfur monochloride under the reaction conditions, said "motor polymer" being added in increments to a mixture of said sulfur monochloride and said diluent, and said base being present at all times in the reaction mixture in molal excess of the amount of sulfur monochloride reacting with the "motor polymer" to neutralize by-product hydrogen chloride as fast as it is formed, said product being clear, light-colored and substantially free from free chlorine and loosely bound chlorine.

High Temperature Lubricating Grease—Patent #2,581,127—Arnold J. Morway and John J. Kolfenbach, assignors to Standard Oil Development Co.

A lubricating grease composition comprising a lubricating oil thickened to grease consistency with 1 to 2 parts by weight of a metal salt of a low molecular weight acid and 1 to 10 parts of a metal soap of fatty acids having between 12 and 24 carbon atoms per molecule, said low molecular weight acid having the general formula

R—CO—COOH

where R is an aliphatic hydrocarbon group of 1 to 5 carbon atoms.

BOOK REVIEWS

Performance of Lubricating Oils

By H. H. Zuidema
Reinhold Publishing Corp., New York, 1952, 179 pages. Price $5.00

This useful new book, amply supplied with helpful charts, tables and illustrations, summarizes and evaluates the wealth of data on the performance characteristics of lubricating oils under various conditions.

The subject is approached from the point of view of performance (oxidaton, bearing corrosion, etc.) rather than specific application (aircraft oils, motor oils, etc.) because performance characteristics are considered to be of a more basic nature than the properties of an oil for specific use. Entire chapters are devoted to such important topics as the lubrication process, flow characteristics, sludge and lacquer deposition, emulsification and foaming, with ample reference to viscosity, pour point, and extreme pressure lubrication. Worthy of special mention is the chapter on manufacturing methods, designed to point out the effects of each step in the manufacturing process upon the performance characteristics of the final product.

This book should prove of considerable value to technical men concerned with the development, manufacture and use of lubricating oils, and to everyone interested in lubrication problems regardless of application.

"Performance of Lubricating Oils" is one of the American Chemical Society's Series of Chemical Monographs. As such, it provides a full and critical treatment of the specifically defined subjects which are presented, together with extensive but critically selected references to the literature.

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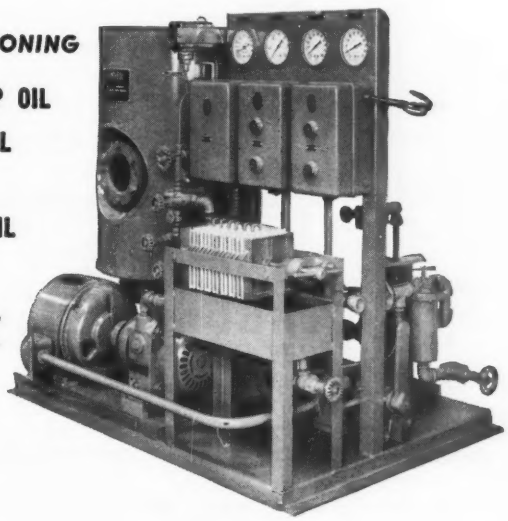

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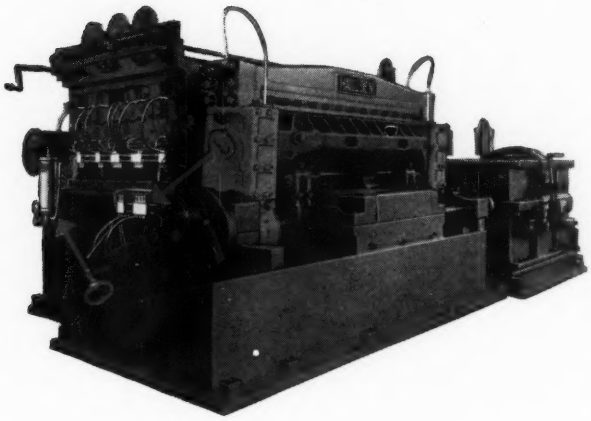
Farval solves the lubrication problem on Automatic Shears

FARVAL—*Studies in Centralized Lubrication* No. 128



KEYS TO ADEQUATE LUBRICATION— ***Wherever you see the sign of Farval—the familiar valve manifolds, dual lubricant lines and central pumping station—you know a machine will be properly lubricated. Farval manually operated and automatic systems protect millions of industrial bearings.***

Photo by courtesy The Hallden Machine Company.

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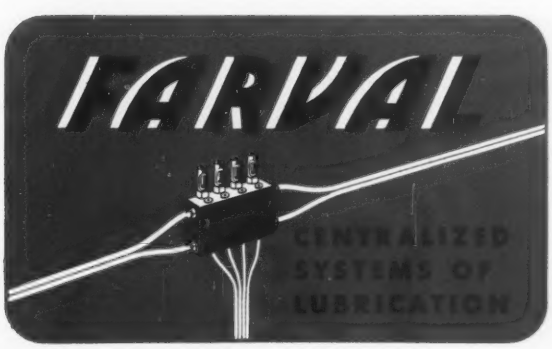

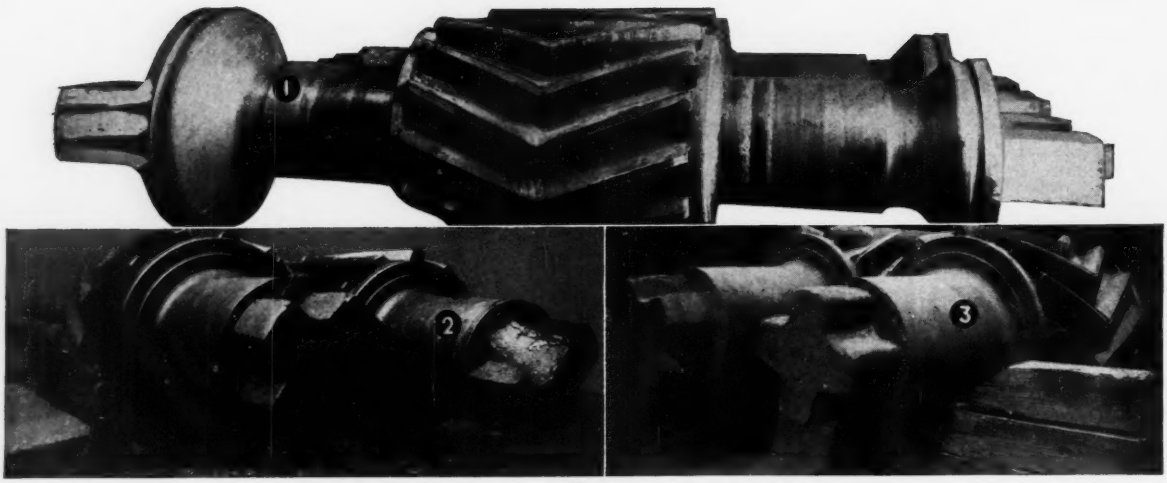

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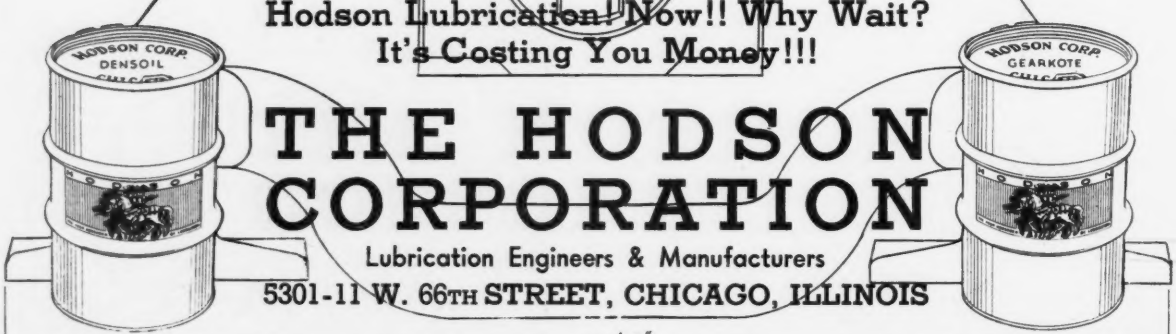

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